AIR CONDITIONING HEATING AND VENTILATING

JULY, 1956 – 53rd YEAR

Air outlets and lighting panels serving the Coliseum. See: Coliseum Has Air Ducts Placed in Floor Slabs—page 89

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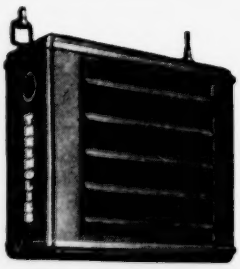
HEAT

you have it today . . . but how about next winter?

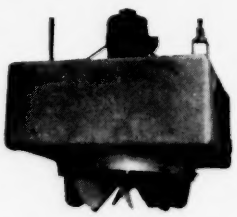
better get set now...with

GRINNELL UNIT HEATERS

Horizontal Gas-Fired Model for natural, manufactured, mixed and LP Gases.



Horizontal Model for steam and hot water systems.



Vertical Model for steam and hot water systems.

Grinnell quality is well known. The "Grinnell" name is backed by over 60 years of heating experience. Regardless of the type and model you choose, you can depend on a Grinnell Unit Heater to give balanced heating performance plus maximum fuel economy. Call on Grinnell . . . for the unit heater to meet your specific needs.

GRINNELL
Gas-Fired Unit Heater

Available in 7 sizes — ranging from 25,000 to 200,000 Btu per hour input

Grinnell Gas-Fired Unit Heaters are easy to install, simple to operate and maintain. Efficient performance is assured — with any type of gas — by modern design of burners and heat exchanger, proper motor and fan unit. Automatic safety pilot operates to shut off main gas supply if pilot goes out. Flashback and extinction noise prevented by the burners' raised port design and proper port size for the gas used. American Gas Association approved.

GRINNELL THERMOLIER
Steam/Hot Water Unit Heater

4 models . . . 18 sizes — from 35,600 to 275,300 total heat delivered, Btu per hour

Three basic models—horizontal, vertical and a special horizontal Textile model. (Adjustable velocity nozzle also available for use on horizontal models.) All models have plain thermostatic trap, the simplest and least expensive kind of a trap, made practical because of unit's exclusive internal cooling leg; maximum capacity provided and destructive water hammer eliminated by built-in pitch of tubes. Many other important features.

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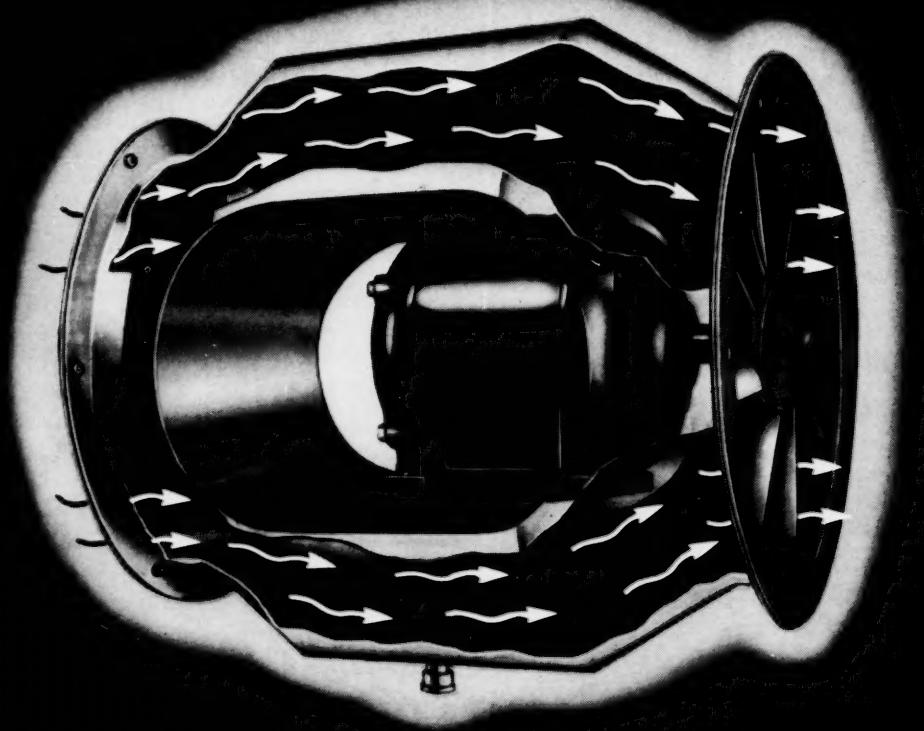
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



YOU PAY NOTHING for the very element that makes THE DIFFERENCE in Bifurcator® Fume Removal

The important, cost-free element is DeBothezat's 30 years experience in designing top efficiency into a bifurcated-housing fan and in applying this fan unit to fume removal problems.

You can confidently specify a DeBothezat Bifurcator . . . install it . . . and have trouble-free operation.

De Bothezat FANS
A DIVISION OF
American Machine and Metals, Inc.
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DeBOTHEZAT FANS DIVISION, DEPT. HV-756
American Machine and Metals, Inc.
East Moline, Illinois

☐ Send Bulletin DB-37-55 containing complete data on the Bifurcator for exhausting corrosive fumes.
☐ Have a DeBothezat representative call.

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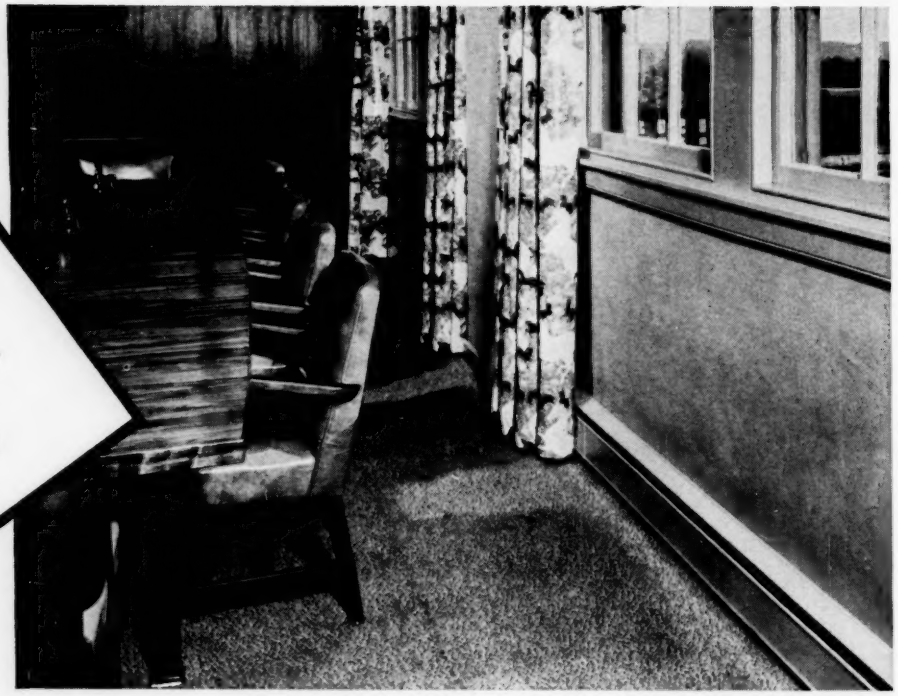
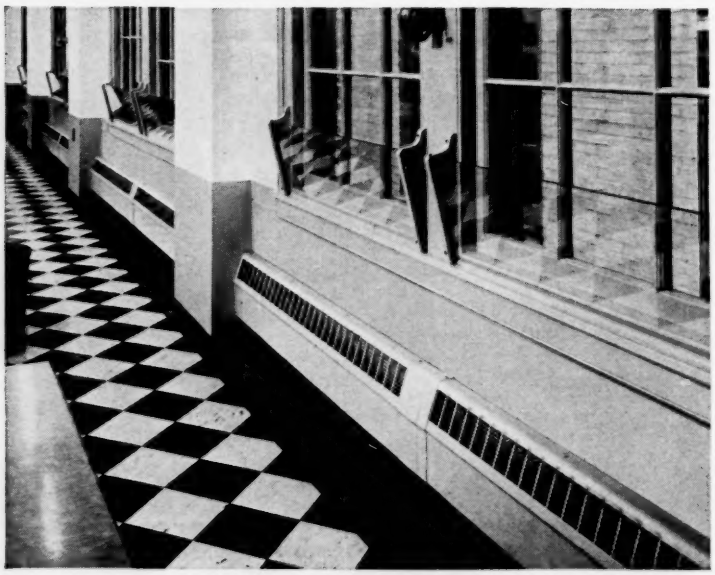
ATTENTION MR. _____

WEBSTER BASEBOARD HEATING, in conference room of Textile Machine Works, Reading, Pa.



A New Concept in Wall-To-Wall Comfort

Tru-Perimeter Heating



WEBSTER WALVECTOR, in offices of Textile Machine Works, Reading, Pa.

Webster Tru-Perimeter Heating — with steam or forced hot water — creates a barrier of gentle warmth against the incoming cold along every exposed wall, in modern buildings everywhere. Webster Tru-Perimeter Heating provides uniform warmth with minimum floor-to-ceiling temperature difference, assures minimum fuel cost, sacrifices no usable floor space.

Webster Tru-Perimeter Heating meets all requirements:

- Webster Walvector with newly-styled and improved enclosure meets the requirements for most non-residential buildings;
- Custom Webster Walvector designed for complete buildings achieves economy in first cost by effectively coordinating heating applications with building design;
- Webster Baseboard Heating serves residential and many other buildings.

Webster Tru-Perimeter Heating teams with air conditioning for year-round heating and cooling comfort. For Tru-Perimeter Heating advantages, see your Webster Representative, or write us.

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For Steam or Hot Water Heating

AIR CONDITIONING HEATING AND VENTILATING

JULY, 1956

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The Cover: Flexible conduits carry air through sound boxes and then through ceiling diffusers in the Coliseum, New York City. Photo by PFI. See article beginning page 89.

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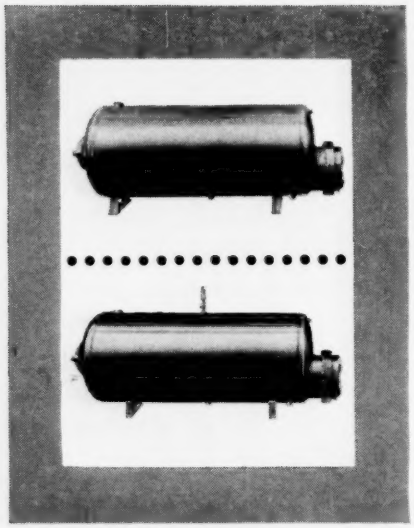

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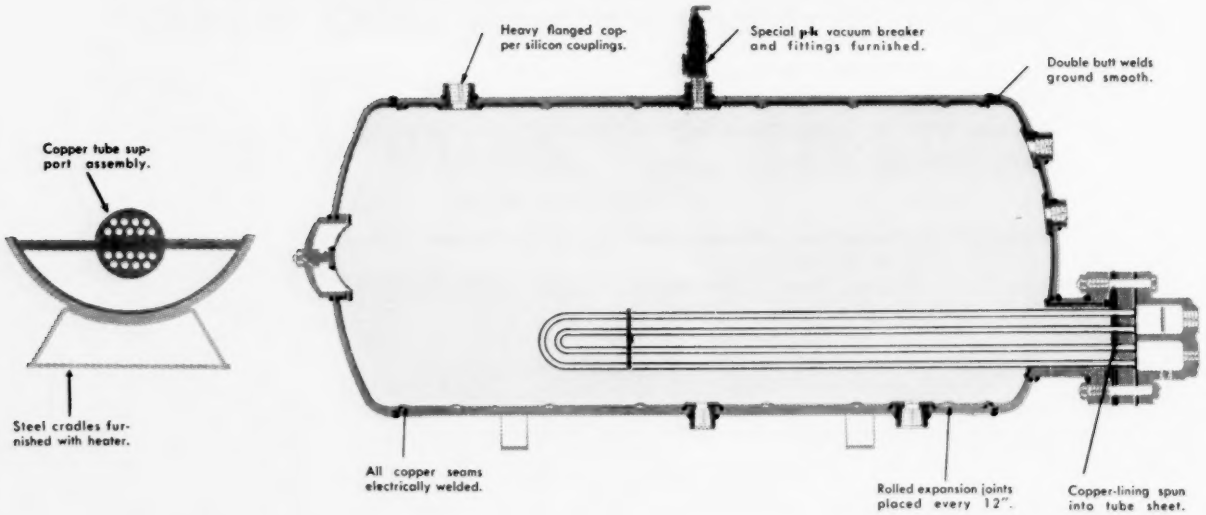
Copper-Lined HEATERS

WOULD YOU SPECIFY?

ONLY ONE has all these features


Heavy flanged copper silicon couplings.
Special p-k vacuum breaker and fittings furnished.
Double butt welds ground smooth.
Copper tube support assembly.
Steel cradles furnished with heater.
All copper seams electrically welded.
Rolled expansion joints placed every 12".
Copper-lining spun into tube sheet.

Like twins, copper-lined heaters can look pretty much alike—on the outside. But *inside*, and on key points of construction, they can be as different as day and night.

Engineers experienced in copper-lined heaters are aware of these vital differences and specify accordingly.

They insist, for instance, on rolled joints every 12 inches around the full circumference of the lining to allow for longitudinal expansion . . . on the copper-lining being not less than 3 lb. per square foot . . . on heavy flanged copper silicon couplings, welded to both the shell and the lining . . . on enough tube supports . . . on an adequately long tube bundle with parallel "U" bends . . . and on a vacuum breaker valve to protect the lining from sudden pressure fluctuation. They make sure that separate hydrostatic and pneumatic tests are run to guarantee that linings will be leakproof.

These experts specify these details, and others, found only in P-K heaters, because they know that heaters built *without* such safeguards are false economy; but that heaters "built right," like P-K's "Indestructo" copper-lined heaters, assure trouble-free service year after year.

Like the full story? We've detailed the key construction features in sample specifications and in P-K's new Catalog 19. Ask your local P-K representative for copies or write today.

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storage water heaters • instantaneous heaters • convertors • fuel oil heaters • freon chillers and condensers

HIGH SPOTS

• **No. 6 fuel oil is much heavier today** than it has been in the past, and it is safe to predict that it will be even heavier in the future, according to G. W. Bohn, of Preferred Utilities, in a talk before the recent convention of the Oil Heat Institute. See page 132.

• During a visit to the British Industries Fair in London, John W. James, vice-president of McDonnell & Miller, Inc., was formally presented to Queen Elizabeth II and the Duke of Edinburgh.

• **Rumors of shortages** of small commercial sizes **of hard coal were denied** by the Anthracite Industry Council in a statement guaranteeing delivery of ample supplies of steam sizes for the coming winter. See page 128.

• The first high-velocity, **electronic air conditioning system** in a hotel is being installed in the Barbizon-Plaza in New York City as a result of the joint research and development work of the Trane, Barber-Colman, Minneapolis-Honeywell, and Westinghouse Companies.

• For the first quarter of this year, steel **boiler sales were 2% above** sales for the corresponding period **last year.** With building permits in excess of last year and with the continuation of a heavy volume of industrial, commercial, and institutional construction, manufacturers anticipate another good year in 1956.

• Approximately **720 tons of air-to-air heat pump air conditioning systems,** operating in forty-seven different localities, are now being supplied by a Southern California power company.

• **Heavy construction awards** amounted to $443.5 million for the week ended June 21, according to a report by *Engineering News-Record* and *Construction Daily*. This figure lifted the cumulative total for the first 25 weeks of this year to $10,947.3 million, which was 22% above the corresponding period in 1955.

• At the close of last year, **21,637 plumber and pipefitter apprentices** were registered by the National Association of Plumbing Contractors as active in the United States. California led the list with 2544; Wyoming had the least with 38.

• At a special meeting on June 25 **York Corporation's stockholders approved the merger of the company** with Borg-Warner Corporation. They also voted to change its name to Lauer Corporation to complete its liquidation; Borg-Warner has also purchased the rights to the York name.

• Plans are being made **to produce heavy water** for atomic-fission materials **from the natural steam of Iceland.** In three fields alone, steam jets with a temperature of 350 deg F shoot skyward at an annual rate of 4000 tons.

• **Air conditioning** in bedrooms and living rooms **is being featured** in the Royal York Apartments under construction in New York City. The project consists of two 12-story buildings, each containing about 250 apartments.

• Rensselaer Polytechnic Institute is conducting a **fourteen-week course in reactor engineering** for 106 scientists and engineers at the Reactor Development Division of Combustion Engineering, Inc., at Windsor, Conn.

• Improved techniques for **long range weather forecasting** are a possible by-product of the research planned for a new observatory on Mauna Loa volcano in the Hawaiian Islands. A greater knowledge of solar radiation is also expected because the observatory is situated well above the bulk of the moisture contained in the earth's atmosphere.

WASHINGTON OVERTONES

by LORING OVERMAN

For the air conditioning, heating, and ventilating industries, the most pleasant Washington overtone during June was the 12-to-2 concensus that the months ahead will be accompanied by very good business conditions.

• Foregoing conclusion stems from the first **mid-year business forecast** symposium for the press, conducted June 15 by the United States Chamber of Commerce. Participating as panelists were spokesmen for fourteen national trade associations representing activities linked closely to the state of the nation.

• Twelve of the panelists expect **business conditions to be extremely favorable** for the balance of 1956; auto industries concede an alarming let-down; and a banker-spokesman predicts a general slowdown unless some way can be found to siphon more funds into the credit reservoir.

Each of the four panels—agriculture, distribution, construction, and finance—brought out something of interest to members of the air conditioning, heating, and ventilating industries.

• **Farm situation,** for instance, is **in a transition stage,** tending toward fewer, larger, and better-equipped units. Market ahead for more plumbing, heating, air conditioning, and refrigerating!

Distribution panel—dealing with retail stores, hotels, and shopping centers—held golden promise for readers of this column.

• A food chains' spokesman reported **"more new supermarkets to be constructed** in the next six months than in the same period of 1955—a vote of confidence in business ahead."

• American Hotel Association reported its members engaged in a $3 billion expansion and improvement program. "One of the greatest trends," said the hotel panelist, "is the **air conditioning of guest and public rooms.** It goes on unabated."

• National Retail Dry Goods Association reported business booming, with expansion plans afoot. Recent NRDGA survey showed that two in five retailers plan major capital improvements this year; **one in three will air condition;** one in four will expand main store; one in five will add a branch in a shopping center.

Reports of the construction panel revealed the **only slowdown to be in lower-priced housing.**

• Total for 1956 is now estimated at **1,100,000 housing starts;** the third largest total in history and still an astronomical figure by previous standards. "Primary problem," said the spokesman for the National Association for Home Builders, "is mortgage money. Not a gloomy picture; merely realistic. Despite problems, a good market in most communities."

• 1956 may still be a **$60 billion construction year,** with an upsurge of non-residential construction offsetting the decline in home building. This is the view of the Associated General Contractors.

• **"All records** for contracts awarded **were broken in first quarter** of 1956; they continue at record-breaking pace," say AGC spokesmen. "By 1965, when the gross national product is expected to reach $500 billion, construction's normal 15% share should exceed $75 billion."

• An architects' spokesman at the mid-year forecast symposium reported steady progress on the drawing boards, with school buildings closely followed by commercial work. A fast upturn of private **industrial construction is expected to increase** even further, with plant and equipment expenditures substantially higher than 1955.

Structural steel, sometimes considered a bottleneck of the construction industry, is expected to become available in increasing quantities as the year progresses.

• **Overall demand for steel**—due to auto slump—**is contracting,** releasing addi-

(Continued on page 8)

are the **BEST** *vapor barriers*

CONDENSATION IS DESTRUCTIVE

Inflow or outflow of HEAT through roofs and walls causes discomfort, increases heating and cooling bills. Inflow in summer or outflow in winter of WATER VAPOR not only causes discomfort, but its condensation to liquid water fosters timber rot, peeling paint, cracking plaster, crumbling mortar, rust and corrosion. It can make sills, studs, beams and plates decay; necessitate costly recurrent repairs. Sufficient vapor is generated weekly in the average home by a family of four, to condense into 76 quarts of water!

Vapor flowing out of a building in winter also entails a heat loss. It takes 1,060 Btu's to convert 1 lb. of water to vapor. The same amount of heat (from *only* 1 lb. of vapor), will raise the temperature of the air in TWO 13′ x 14′ rooms, with 8′ ceilings, from a cold 50°F to a warm 70°F.

DENSE MOLECULAR STRUCTURE

Because of their dense molecular structure, metals have a vapor permeability of almost zero; will permit little or no vapor to pass. **Metals are the best vapor barriers.**

Fortunately, there is available an effective and inexpensive metallic barrier to vapor, which is also a most efficient thermal insulation. It consists of successive sheets of aluminum, permanently air-spaced apart, in pre-fabricated form, which open up automatically as installed. It comes in continuous lengths up to 750′; with no "breaks" every few feet for accelerating the flow of heat and of vapor. Because of its scientific construction, condensation on or within it is minimized.

Each reflective surface of each sheet of aluminum has 97% reflectivity and 3% absorptivity and emissivity for Radiation or heat-rays. (Radiation represents 50% to 93% of all heat flow through building spaces, depending on direction.) Because of multiple air spaces of low density, heat flow through it by Conduction is slight. The multiple sheets of fiber and aluminum retard Convection.

NATIONAL BUREAU OF STANDARDS TESTS

The National Bureau of Standards conducted a remarkable series of tests to determine if condensation can form in or on reflective **aluminum** when exposed to considerable vapor as in crawl spaces. The results were published by the Technical Division of the National Housing Agency as "Technical Bulletin No. 38." Those interested in retarding condensation formation and the flow of heat and vapor, will find this booklet invaluable for study and reference. We will send a copy free if you'll fill in the coupon.

INFRA INSULATIONS CAN BE PURCHASED everywhere through your preferred local dealer for 3¢ to 12¢ per sq. ft. depending on the type.

Infra Insulation, Inc., 525 Bway., N.Y.C., Dept V-7

Please send NHA's "Technical Bulletin No. 38."

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ADDRESS

WASHINGTON OVERTONES (*Continued from page 6*)

tional supplies for other uses. Also an extra million tons capacity in structural sections is promised—with 50% traditionally made available to fabricators of structural steel.

• Symposium panelists advised against considering housing starts, auto production, and steel output as the **sole yardsticks of national prosperity.**

• Commented Dr. Emerson P. Schmidt, Director Economic Research Department, United States Chamber of Commerce: "While the expansionist and contractive forces are always vying with each other and today are rather evenly poised, there is good reason to believe that in the period ahead the expansionist forces will outweigh the contractive. To a considerable extent, readjustments in soft sectors of our economy have already been absorbed. **The readjustments are,** for the most part, **behind us,** while the economy has operated at virtually full capacity.

All of the panels predicted their forecasts of a favorable future on the **availability of adequate capital.** Some panelists complained that credit reins had been drawn too tight; other commended the Federal Reserve for timely closing of the money floodgates: all stressed the importance of being a step ahead of the game if the need for additional funds becomes apparent.

Proponents of a financial shot in the arm for the economy frequently mention an income tax cut as a most acceptable means of accomplishing such a result.

• The anchor man for the symposium observed: "Expenditures (government) are running about even with a year ago, and there is a **cash surplus** in sight which **may pave the way for a suitable tax reduction,** if needed, before the current session of Congress. A tax reduction of $2 to $3 billion with a general cut in all income taxes, a further reduction in steeply graduated brackets, plus a readjustment of wartime excise taxes, and a reduction in the corporate rate to 50% would leave in the hands of the consumer and business additional funds for financing expenditures and badly needed new investments."

If Congress is considering any tax reduction moves, they do not show up yet in lists of must legislation. With mid-July still the target date for adjournment, but with delays likely, the legislative program looks like this:

• **Major legislation enacted:** military reserve program; Formosa defense; reciprocal trade extension; pay raises for Congressmen, judges, and Federal employees; corporate and excise tax extension; reorganization powers; minimum wage increase; soil bank program.

• **Vetoed:** Natural gas bill and farm bill.

• **Passed House and Senate:** Highway construction, in conference.

• **Passed Senate:** new public housing.

• **Passed House:** Social Security broadening (pending on Senate calendar); Defense production powers; foreign aid extension (in Senate Foreign Relations Committee).

• **On House Calendar:** Postal rate increases.

• **Pending in committees in both Houses:** Alaska-Hawaii statehood; Federal aid for schools; health insurance, and civil rights.

Washington was headquarters for heating, ventilating, and air conditioning engineers from the United States and Canada on June 18. The occasion, a semi-annual meeting of the American Society of Heating and Air Conditioning Engineers.

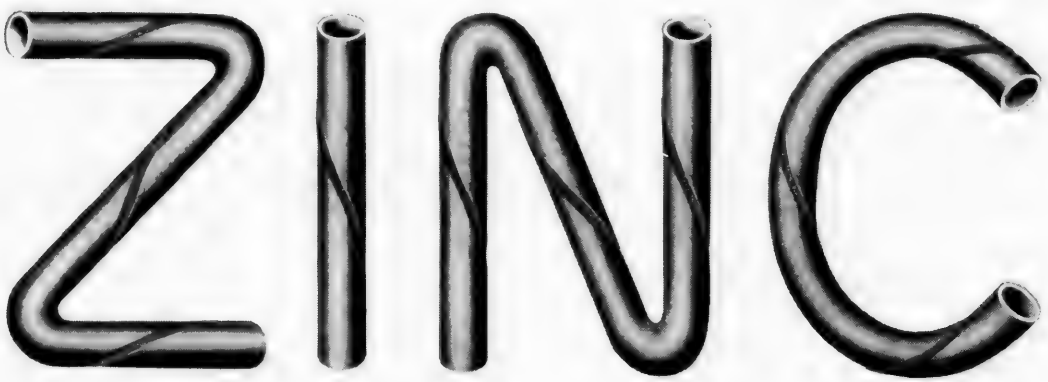
• Features: **discussion** of standards and codes; **symposium** on new developments; fourteen **technical presentations** on various phases of heating and air conditioning.

Appropriation of $2 million a year in **Federal funds for anthracite coal research** was suggested to the special Coal Research Subcommittee of the House Interior Committee to study both new uses for anthracite and improved mining methods.

• "Research on gasification," said the recommendation of the Anthracite Institute, "should include the production of a high Btu heating gas **to supplement natural gas** and an investigation of a program for the production of synthesis gas for reforming in order to obtain gasoline, fuel oil, and alcohols."

An engineering fact...

WROUGHT IRON PIPE takes up to a 50% heavier coating of ZINC



Tests prove the iron silicate fibers which give wrought iron its unusually high resistance to corrosion are also responsible for the material's ability to accept a considerably thicker hot-dip zinc protective coating than steel.

Our bulletin, *Piping for Permanence*, discusses galvanic protection, and reviews a variety of wrought iron pipe services. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

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These photomicrographs illustrate the ability of wrought iron to receive a tighter, heavier zinc coating. Because the life of the coating is directly influenced by its adherence and weight or thickness, zinc coating on wrought iron lasts longer.

BYERS *Wrought Iron Tubular and Hot Rolled Products*

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

BRIEFLY STATED

• After a fire that destroyed its offices and manufacturing plant in February, the Baltimore Aircoil Co., Baltimore, Md., is back in production. Its evaporative condensers and cooling towers are now available on a normal delivery basis, and the construction of a new plant is in progress.

• Appointment of Frank E. Hodgdon as director of the American Gas Association's laboratories has been announced by the Association. Mr. Hodgdon will head the gas industry's national gas appliance testing and research center. In his new capacity he will serve as Secretary to the ASA Sectional Committee, Project Z21, the AGA Approval Requirements Committee, and as a member of the laboratories' Managing Committee.

• The appointment of Robert A. McLaughlin as general manager of Pittsburgh Plate Glass Company's Fiber Glass Division is announced by David G. Hill, president. Prior to his appointment, Mr. McLaughlin had served as director of sales since 1952 when the division was formed.

• Walter M. Hassenplug has been named director of engineering for Acme Industries, Inc., Jackson, Mich. Just prior to joining Acme, Mr. Hassenplug was associated with the Air Conditioning Div. of General Electric Co. at Fort Wayne, Ind., working as manager of hermetic motor engineering.

• A. William Fraser and Clarence S. Wentworth have been appointed commercial vice presidents of Worthington Corporation by the board of directors. Mr. Fraser, who has been Midwest regional sales manager since 1951, is in charge of the district sales offices at Chicago, Denver, Kansas City, St. Louis, and Minneapolis. His headquarters are at Chicago. Mr. Wentworth is sales manager of the Central region, with headquarters at Cleveland and is responsible for the district sales offices at Buffalo, Cincinnati, Cleveland, Detroit, and Pittsburgh.

• John Wood Co., manufacturers of water heaters, tanks, gasoline pumps and metal dairy equipment has purchased the Fluid Heat Div. of Anchor Post Products, Inc., Baltimore, Md. The transaction covers the machinery, equipment and inventory in the Baltimore plant and also the plant site and buildings, machinery, and inventory at Red Oak, Iowa. The company plans to move the machinery and equipment from Baltimore and integrate it within one of its plant locations at Conshohocken, Pa., maintaining the facilities at Red Oak, Iowa, to serve western customers. By reason of this expansion, the company will soon market a line of furnaces, conversion burners, and summer air conditioning units.

• Charles M. Heathman, recently a Brunner sales representative in the Chicago area, has been appointed service manager of The Brunner Co., Gainesville, Ga. As service manager, Mr. Heathman will be responsible for the coordination of field service, parts distribution, returned materials and warranties on the semihermetic condensing units and motor compressors manufactured in the Georgia plant.

• Gene Gribble has been placed in charge of research and development at Shaw-Perkins Mfg. Co., West Pittsburgh, Pa. His duties will include direction of the company's research laboratory and radiator development department.

• Francis R. Vanlandingham has been appointed manager of distribution development of the General Electric Company's Weathertron Department in Bloomfield, N. J. Mr. Vanlandingham will be responsible for the study and development of distribution policies, plans and programs, and the development of distribution at the wholesale and retail level with respect to caliber, organization and growth.

• William A. Marshall recently joined the staff of The Trane Company's product engineering department as a development engineer. He has been assigned to do work in connection with the company's development program on packaged air conditioning systems.

• John W. Newton, former account executive with Harshe-Rotman, Inc., a public relations agency, has joined the public relations department of Carrier Corporation. Mr. Newton will serve as national publicity representative. He is a former editorial staff member for both the Peekskill (N. Y.) *Evening Star* and the *New York Journal American*.

• Appointment of Lee D. Nutter as manager of builder sales has been announced by General Electric Company's home heating and cooling department. Mr. Nutter was previously district sales representative for the air conditioning division in the Chicago area.

• A. W. Plier was re-elected president and general manager of D. J. Murray Mfg. Co., Wausau, Wis., at the recent annual meeting of the board of directors following the annual stockholders' meeting. Other officers re-elected are M. P. McCullough, Chicago, Ill., vice president; S. D. Payzer, vice president in charge of engineering; W. A. Marquardt, secretary and assistant manager; G. L. Ruder, treasurer; P. W. Hoeper, assistant secretary; and Fred C. Boyce, Wauwatosa, Wis., assistant treasurer.

• Bryant Division of Carrier Corporation has begun construction of an administration and engineering research building at its national headquarters in Indianapolis, Ind. Upon completion of the new building, Bryant will move its offices from their present downtown location at 48 Monument Circle to 2020 Montcalm Street on the near west side of Indianapolis.

• Following a personal survey of distributors in the field, R. H. Jones has assumed his newly appointed responsibilities as general manager of the air conditioning division of General Electric. The division includes three product departments: the commercial and industrial air conditioning department; the home heating and cooling department; and the Weathertron department. One of the three air conditioning components, the home heating and cooling department, is moving its headquarters from Bloomfield, N. J., to Tyler, Tex., where it has recently completed a $15-million plant.

(*Continued on page* 12)

And in New Jersey — A FUTURE OF FAULTLESS SERVICE

MANUFACTURING PLANT, OFFICE and RESEARCH FACILITIES
ETHICON, INC.
Bridgewater Township, N. J.

SERGE P. PETROFF & ASSOCIATES
architects

MUZILLO & TIZIAN
mechanical engineers

RICHARDSON ENGINEERING CO.
mechanical contractors

RARITAN SUPPLY COMPANY
wholesale distributors

ELJER CO.
plumbing fixtures manufacturer

"Factories can be beautiful" has long been a motto of Johnson & Johnson, parent company of Ethicon, Inc. Dramatic proof is embodied in this strikingly efficient COYNE & DELANY installation now under completion for the world's largest manufacturer of surgical sutures and other allied products. Located on a 200 acre tract of the former Raritan Valley Farms, Ethicon has spared no detail in creating a functional plant in a park like setting. Appropriately enough, DELANY diaphragm type flush valves are installed throughout in accordance with specifications. When the finest in mechanical equipment is mandatory, look for DELANY "the fastest growing name in flush valves!"

This new "HAND BOOK and CATALOG No. 53" is the most comprehensive of its kind—designed for everyday reference . . . 19 pages of installation details for exposed, concealed and special FLUSH VALVE installations . . . over 75 blue prints . . . cut away views . . . many pages of charts, formulae, piping details . . . sent free, if requested on firm letterhead.

COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK
IN CANADA: THE JAMES ROBERTSON CO., LTD.

DELANY *Flush* **VALVES**

Since 1879

BRIEFLY STATED

(*Continued from page* 10)

• Executive appointments in two of its major sales divisions have been announced by Crane Co. They are: J. W. Greene who was named director of industrial sales and W. A. Burbine who became director of heating sales. Both men have been promoted from their posts as district managers.

• George L. Leupold has been appointed assistant general sales manager of Fulton Sylphon Div., Robertshaw-Fulton Controls Company. He will make his office at division headquarters, Knoxville, Tenn. Mr. Leupold joined the company in 1946 as district manager of the Cincinnati office.

• The promotion of three sales personnel has been announced by Rockwell Mfg. Co., Meter and Valve Division. Gilbert T. Bowman, general products manager, and J. W. Northcutt, Southern regional sales manager, have been named assistant vice-presidents. Both will make their headquarters in Pittsburgh. Jack H. Walters, product manager of petroleum and industrial liquid meters, will move to the company's Southern regional headquarters in Atlanta, Ga., to succeed Mr. Northcutt.

• The board of directors of Bell & Gossett Company, Morton Grove, Ill., has elected R. Edwin Moore to the office of president of the company. Earl J. Gossett, who has served as chairman and president, will continue as chairman of the board of directors. Mr. Moore joined the company in 1927. In 1934 he became vice-president in charge of sales and in 1954 was elected executive vice-president.

• Wagner Electric Corp., St. Louis, Mo., announces the consolidation of its electrical and automotive engineering and research facilities under the direction of P. C. Ford, newly appointed executive engineer. Under the new organization, C. E. Widell was appointed director of research and development.

• Appointment of Charles D. Branson as assistant director of research of Robertshaw-Fulton Controls Co. has been announced. Mr. Branson will make his office at the company's eastern research facility, at Irwin, Pa.

• A. W. Cash Co. announces the opening of new offices at 115-117 South Main Street, Decatur, Ill. Former office space at 18th and Eldorado Sts., in Decatur, has been converted to manufacturing facilities.

• Clinton F. Hegg, vice-president of L.O.F Glass Fibers Company, has been named general sales manager. He was formerly in charge of the automotive sales division. In his new post, Mr. Hegg replaces J. M. Johns and will be located at the firm's general offices in Toledo, Ohio.

• Thomas H. Ford has been appointed assistant to the vice-president of Fedders-Quigan Corp. Mr. Ford comes to Fedders from Whirlpool-Seeger Corp. where he held the position of product manager in the air conditioning department.

• James R. Erven, previously branch manager of the New York office has been named vice-president and sales manager of Kennedy Valve Mfg. Co. Mr. Erven joined the company in 1950 as a salesman in the New Orleans office and was moved to his post in New York in 1952.

• McDonnell & Miller, Inc., Chicago, Ill., has announced the election of Bill Gleeson as vice-president. Mr. Gleeson has been with the company for more than nine years and was formerly district sales manager for the West Coast. He will continue in his present capacity as sales promotion manager, with offices at the company's main plant. Mr. Gleeson is known to the heating industry for his lecture work on the subject of boiler safety.

• Glenn E. Seidel has been appointed to the newly-created position of vice-president in charge of engineering for Minneapolis-Honeywell Regulator Company. Mr. Seidel has been a member of the company's engineering organization for nearly fourteen years and since 1952 has been vice-president in charge of engineering in the firm's Minneapolis plants.

• The sale of the Union Asbestos & Rubber Company's heating division to Batavia Kritzer, Inc., Batavia, Ill., for an undisclosed sum, has been completed, according to a joint announcement by both firms. The sale does not affect Unarco's cooling division. Batavia Kritzer, Inc., will market the former Unarco heating line, including Dual-Vector units and the Hydro-Pac water chillers, convectors, and industrial unit heaters.

• H. G. Ebdon, vice president and general sales manager of Combustion Engineering, Inc., has been named executive vice president by the board of directors. Mr. Ebdon joined the company in 1917 and since 1925 has served successively as manager of the Proposition Department, sales engineer, assistant general sales manager and general sales manager. In 1950, he was elected a vice president.

• Robert S. Ingersoll was elected president of Borg-Warner in a major reorganization of the corporation's top management. He previously was an administrative vice president. Roy C. Ingersoll, formerly chairman of the board and president, was re-elected as board chairman and was named chief executive officer but relinquished the presidency which he has held for six years. Lester G. Porter, previously an administrative vice president, was elected to the newly re-created position of executive vice president. Albert Steg, formerly treasurer and controller, was named financial vice president and treasurer. Robert W. Murphy, vice president and general counsel, was given the additional responsibility of vice chairman of the executive committee. Messrs. Robert S. Ingersoll, Porter, Murphy, and Steg were elected last year to the board of directors. Roy C. Ingersoll has been a director since 1930.

• The appointment of Orville Miller, Jr., as manager of Superfine products sales has been announced by Pittsburgh Plate Glass Company's Fiber Glass Division. Mr. Miller had served as district sales manager in Cleveland, Ohio, since joining the division in 1952.

ASK THE AEROFIN MAN

About Practical Heat Exchange

There is a competent Aerofin heat-transfer engineer near you—qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem—and backed by the research and production facilities of the pioneers in light-weight extended surface.

Ask the Aerofin Man.

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 1, N. Y.

Nesbitt

CONFIDENTIAL

Interoffice Memorandum

You've proved it — Print it — A.J.N.

Date March 7, 1956

To All Nesbitt Sales Offices — From Philadelphia - H. B. Hedges Office

Office — Order No.

Subject Engineering Dept. Tests on Series T Surface (Pub. 345-1)

1. Attached to this memo is a copy of the Engineering Department's new printed report, "An Investigation of Performance of Nesbitt Series T Surface".

2. NOW FOR THE FIRST TIME - PUBLISHED DOCUMENTARY DATA PROVING THE CLAIMS OF UNIFORM DISCHARGE TEMPERATURES AND CONDENSATE FREEZE PROTECTION UNDER MODULATED STEAM CONTROL.

3. The facts of these tests so far exceed our anticipated results on the TROMBONE Steam-Distributing Tube Surface that the decision to publicize this information will have to come from A. J. Nesbitt. For the present, therefore, I am marking this memo CONFIDENTIAL.

4. The significance of these tests lies in the fact that the TROMBONE Steam-Distributing Tube Surface exhibited a marked [illegible] in the field of condensate freeze protection, and simultaneously [illegible] a tremendous advance in the field of steam distribution.

5. TROMBONE Steam-Distributing Tube Heating Surface has given a NEW meaning to the old term "even steam distribution". Now this term applies to all positions of the steam valve and not just to valves at wide open position.

6. Your engineering friends will quickly note that here is a truly new type of heating surface that combines a high degree of control of discharge temperatures at the place where it is most needed - under conditions of modulated control.

7. TROMBONE Steam-Distributing Tube Heating Surface has as much application in reheaters as in preheaters because it provides a positive means of accurate control even in surface sections of 10-foot finned length.

8. This is the greatest and most convincing series of tests ever made within my knowledge of 40 years in the industry.

Berkley Hedges

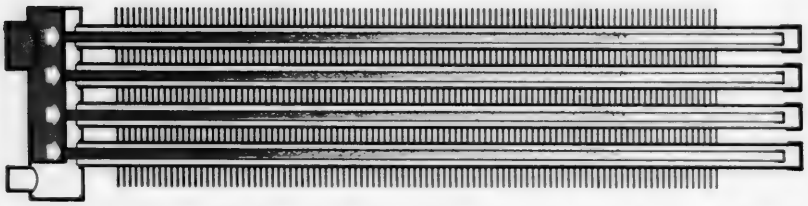
NOW...

to get these results specify NESBITT Series T Heating Surface with the TROMBONE Steam Distributing Tubes

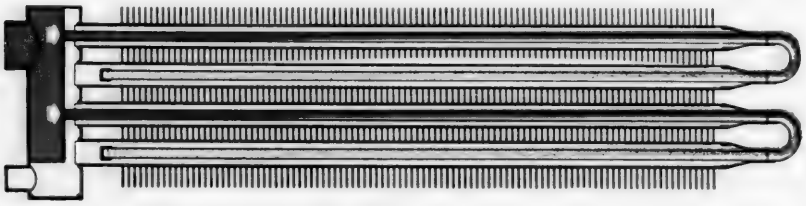
This is NEWS — a series of tests that proves conclusively the broad claims made for Nesbitt Series T Heating Surface: *uniform final temperatures* and *maximum freeze protection over the entire capacity range* — from 100% down to the smallest practicable supply of low-pressure steam under valve control.

Each trombone steam-distributing tube serves two adjacent condensing tubes from a single supply-header connection. Steam must travel across the first leg of the trombone tube (full length of the surface) before reversing, under increased demand, to serve the second leg.

Send for this report (345-1) and Publication 305 to learn why Nesbitt Series T Surface is unmatched for your heating and ventilating use with modulating valve control.



Conventional Surface: Steam apportioned to all tubes in the coil. With a small steam flow, air near supply end is heated; near return end, air is unheated. Results: temperature stratification; condensate subject to freezing.



Nesbitt Trombone Surface: Steam apportioned to *every other* tube. The same steam quantity goes *twice as far* in each tube. Even small quantities are distributed over entire surface area. Results: uniform final temperatures, full length of coil; freeze protection; perfect control with modulating valves.

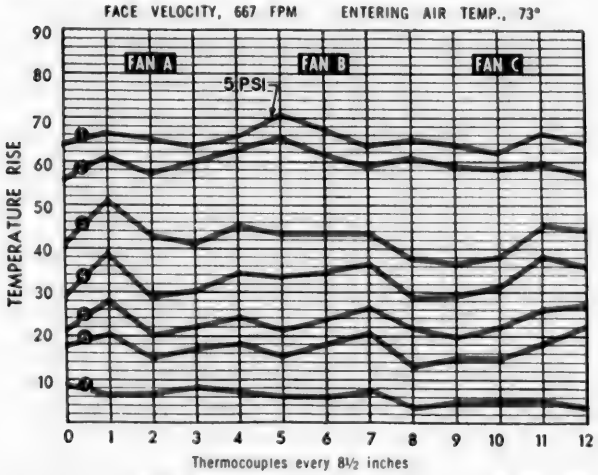
Nesbitt Series T HEATING

ADVERTISEMENT
of John J. Nesbitt, Inc.
Philadelphia 36, Pa.

FOR THE FIRST TIME

. . . published documentary data proving the claims of uniform discharge temperatures and condensate freeze protection under modulated steam control

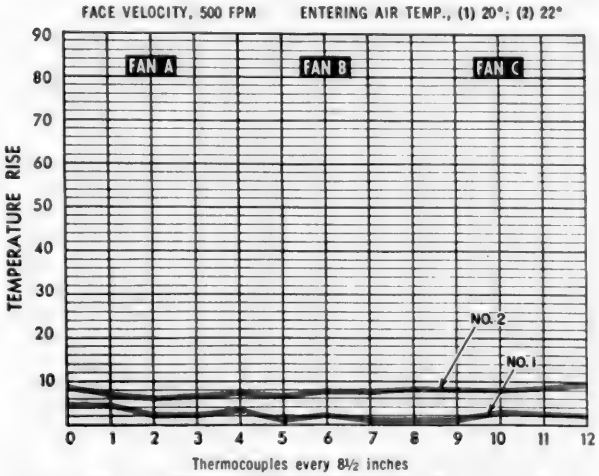
Uniform Discharge Temperatures—Reheating



Curve	Fan Discharge Temperatures A	B	C	Average Rise	% Capacity
1	136	137	137	63.7	100.0
2	129	131	131	57.3	90.0
3	115	116	116	42.7	67.0
4	107	103	106	32.3	50.7
5	97	94	95	22.3	35.0
6	89	89	89	16.0	25.1
7	77	78	78	4.7	7.4

The graph shows that the steam was distributed across the entire length (10 feet) of 2-row surface even under extreme modulation. Fan discharge temperatures were almost constant. This is normal operation for Nesbitt Series T.

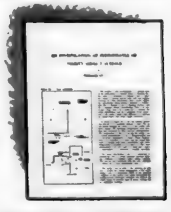
Condensate Freeze Protection—Preheating



Curve	Fan Discharge Temperatures A	B	C	Average Rise	% Capacity
2	29	28	29	6.7	7.46
1	23	22	22	2.3	2.56

This is an extreme test with only a cracked valve; entering and leaving air both sub-freezing. Perfect distribution with only 2.56% of capacity; no condensate freezing nor leaks.

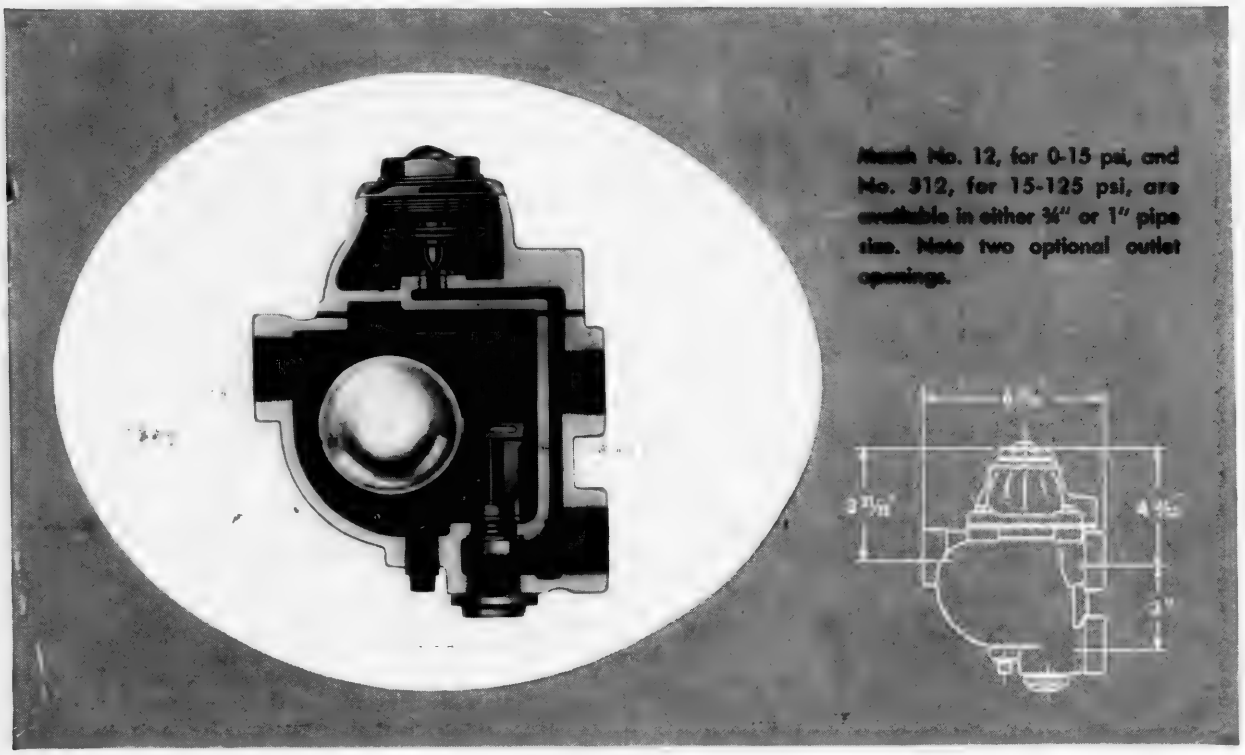
Send for this publication
(No. 345-1) It gives complete information of amazing tests that prove Series T claims.



SURFACE WITH TROMBONE STEAM DISTRIBUTING TUBES

MARSH No. 12

Float and Thermostatic Trap



. . . The most dependable trap you can use

There are many jobs that only a float *and* thermostatic trap can handle properly . . . and in the Marsh No. 12 you have the most respected F & T trap ever developed.

Here is a trap that counts its users in thousands. Repeat orders are the rule because men who know have discovered that no other trap can quite duplicate its absolutely dependable, trouble-free performance in removing all air and condensate from steam mains, branches, risers, unit heaters, coils, and similar applications.

Two precision-built assemblies accomplish this. All condensation is discharged by the float-operated valve located at the low point in the trap body. All air is vented through the by-pass by the action of the thermostatic diaphragm, but this is one of those Marsh diaphragms that closes the valve immediately in the presence of steam. In fact the accuracy of response is the attribute that distinguishes the Marsh thermostatic element. It gets the air out and keeps the steam *in!* Another big feature is the straight through design which eliminates troublesome excess piping.

No. 12 is your F & T trap for those low pressure applications — up to 15 psi W.S.P. but its identical-in-operation companion, No. 512, covers the working pressure range of 15 to 125 psi. There is a Marsh trap for every low or medium pressure application.

Write for catalog 76-H covering Marsh heating specialties

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

Dept. U, Skokie, Ill. Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta

Manufacturers of gauges, thermostatic regulating valves, Solenoid valves, heating specialties

MARSH *Heating Specialties* **SINCE 1865**

In **ALUMINUM** too

here's how to get more for your money!

Call your nearby Tube Turns' Distributor. He can fill *all* your needs in welding fittings and flanges—aluminum as well as other piping materials. He provides industry's most complete line—over 4,000 top quality items —different sizes, types, schedules, materials; hence, this one source saves you purchasing time, cuts red tape. He acts as your warehouse. He gives you prompt delivery. And through him, Tube Turns' Engineering Service gives you valuable application help. To take advantage of this cost-cutting service, specify and buy TUBE-TURN Welding Fittings and Flanges.

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS

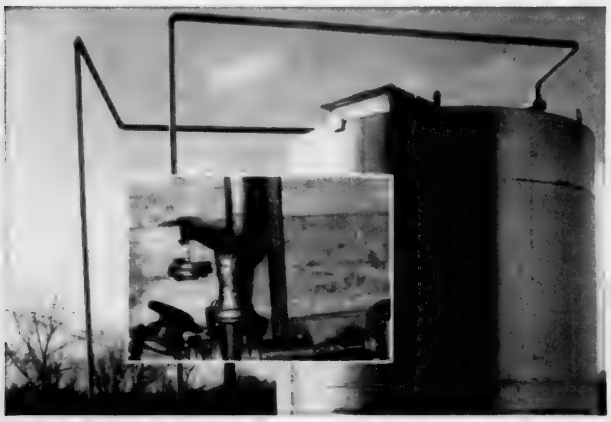
LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

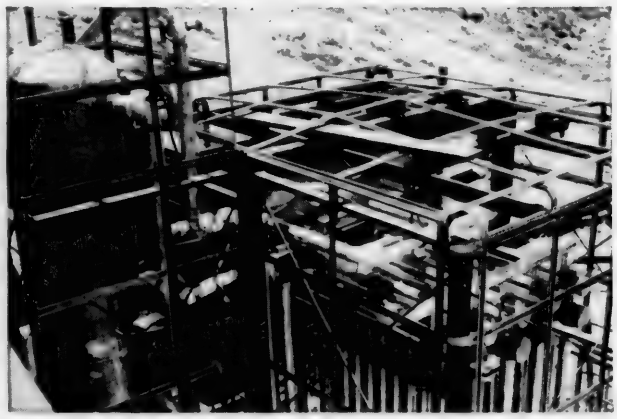
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
Los Angeles • San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

TUBE TURNS' ENGINEERING SERVICE

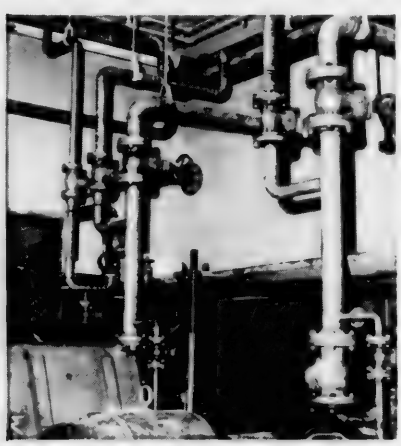
helps you apply aluminum piping on jobs like these...



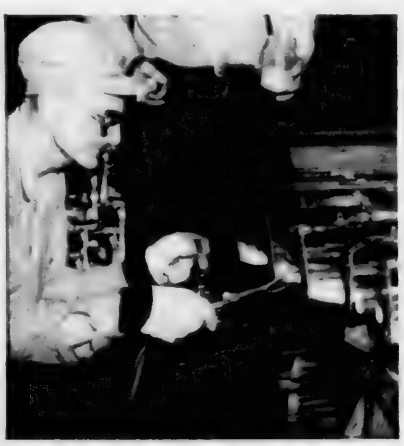
Oleic Acid Storage: Here, 2" aluminum lines carry oleic acid in this installation for a rubber company. TUBE-TURN Aluminum Welding Fittings are used for directional changes. Insert shows a compact combination of these fittings at a pump . . . an elbow, tee, reducer and flange.



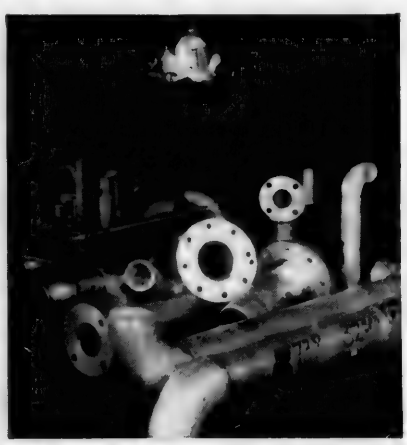
Oxygen Plant: TUBE-TURN Welding Fittings were used throughout this 25 tons-per-day oxygen plant for ore recovery. Here, operating temperatures range from 100°F to –320°F. Picture above shows reversing heat exchangers and fractionating tower prior to being enclosed in insulating shell.



Catalyst Piping: Aluminum piping and fittings were specified for certain services in this new TCR bead catalyst plant to prevent contamination of the catalyst. TUBE-TURN Welding Fittings and Flanges were employed in all aluminum lines from 1" to 10". Result: Lines are permanently leak-proof—maintenance is minimized.



Refinery Wax Coils: Originally, retubing of seven wax sweaters in a large refinery called for coils of another metal. Switch to aluminum piping and TUBE-TURN Welding Fittings saved $50,000 in material costs! Each unit required 900 TUBE-TURN 180° Welding Returns of 1" OD.



Fast Fabrication: TUBE-TURN Welding Fittings and Flanges are dimensionally accurate. Rigid inspection by Tube Turns assures true circularity and uniform wall thickness. Result: Alignment is perfect; fabrication is faster; installation simplified.

TUBE TURNS, Dept. B-4
224 East Broadway, Louisville 1, Kentucky

Please send free copy of new catalog on Aluminum Fittings and Flanges.

Company Name _____

Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

Available from your nearby TUBE TURNS' distributor

DISTRICT OFFICES:

New York	Los Angeles
Philadelphia	San Francisco
Pittsburgh	Seattle
Cleveland	Atlanta
Detroit	Tulsa
Chicago	Houston
Kansas City	Dallas
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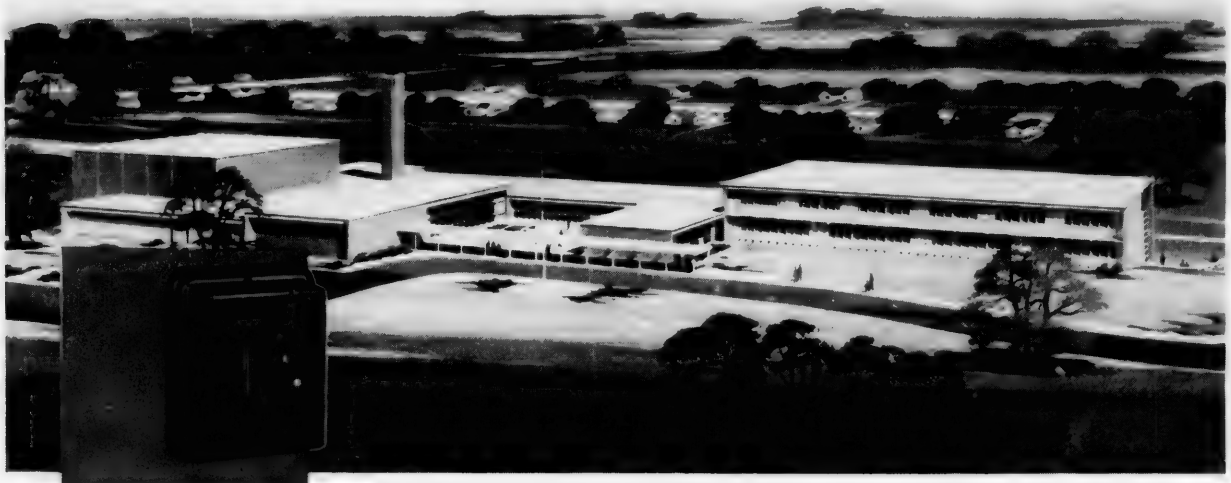
*"TUBE-TURN" and "⊎" Reg. U. S. Pat. Off.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

where there's an "after hours" heating problem...



JOHNSON DUAL CONTROL

Cuts the Cost of Comfort

Northeast Junior High School* is another outstanding example of the way the Johnson *Dual* System of Automatic Temperature Control solves the very special comfort problems of the modern school and provides waste-free heating and ventilating performance.

During regular school hours, sensitive Johnson *Dual* Thermostats, in each individual room, maintain ideal temperatures throughout the entire building. They operate, automatically and efficiently, the Johnson Valves and Damper Operators which control the heating and ventilating effect of convectors and unit ventilators. Refreshing, even temperatures prevail at all times, regardless of outdoor temperatures, exposure, occupancy levels and other variable factors which might otherwise affect student and teacher comfort.

When regular school hours end, each of five groups of *Dual* Thermostats is reset, from a central point, to operate at lower, non-occupancy temperatures. In those rooms that continue in use, merely pressing a button on the room's *Dual* Thermostat restores it to normal occupancy temperature, *without changing the economy settings of the other thermostats.*

Any room, or rooms—auditorium, multi-purpose room or individual classrooms—may be used independently and at minimum cost, since *only the occupied rooms are heated.* With Johnson *Dual* Control, "after-hours" heating problems are completely eliminated and, in the typical school, fuel savings quickly repay the cost of the entire system!

Johnson offers you the benefits of more than 70 years' experience in designing, manufacturing, installing and servicing automatic temperature control systems. With Johnson, all responsibility is centered in one highly specialized organization—the only way to insure the most efficient control installation for every type of building.

A nearby Johnson engineer will be glad to work with you on any control problem. His recommendations are yours without obligation.

*Northeast Junior High School, Johnson County, Kansas. Architects—Peterson & Scharhag, Kansas City, Mo., and Perkins & Will, Chicago. Mechanical Engineers—Howarth, Scott & Kinney, Kansas City, Mo. Heating Contractor—Interstate Heating & Plumbing Co., Kansas City, Mo.

JOHNSON CONTROL
TEMPERATURE AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

JOHNSON SERVICE COMPANY
507-C East Michigan Street, Milwaukee 1, Wisc.

I'd like more facts about *Dual* Control.

☐ Send your folder "How Johnson *Dual* Control Solves the After-Hours Heating Problem in Schools."

☐ Have a Johnson engineer call me.

NAME_____

SCHOOL_____

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CITY & STATE_____

20-year veterans—all—
with Crane "one-cost" service records

A CASE HISTORY—What better hedge could a power plant have against high maintenance costs?

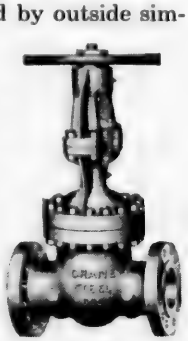
Call it foresight or sound buying practice, the Fort Bend Utilities Co., Sugar Land, Texas, knows the bigger value in quality steel valves. For 20 years now, these Crane 600-pound gates have been operating with no added cost beyond original investment, except for occasional repacking.

The valves are on a main header, with working pressure at 400 psi, 750 deg. F.

As a subsidiary of Imperial Sugar Co., the Fort Bend Utilities plant supplies steam to the neighboring Imperial Sugar refinery through the valve shown being operated. This 8-in. Crane No. 76XR steel gate has to its credit 20 years of faithful once-a-week operation with the refinery's weekend shutdowns. The other valves assure dependable steam control to units in the power plant.

Service records like this result from internal valve quality. They begin with the greater care Crane gives to design, castings, heat treating and machining.

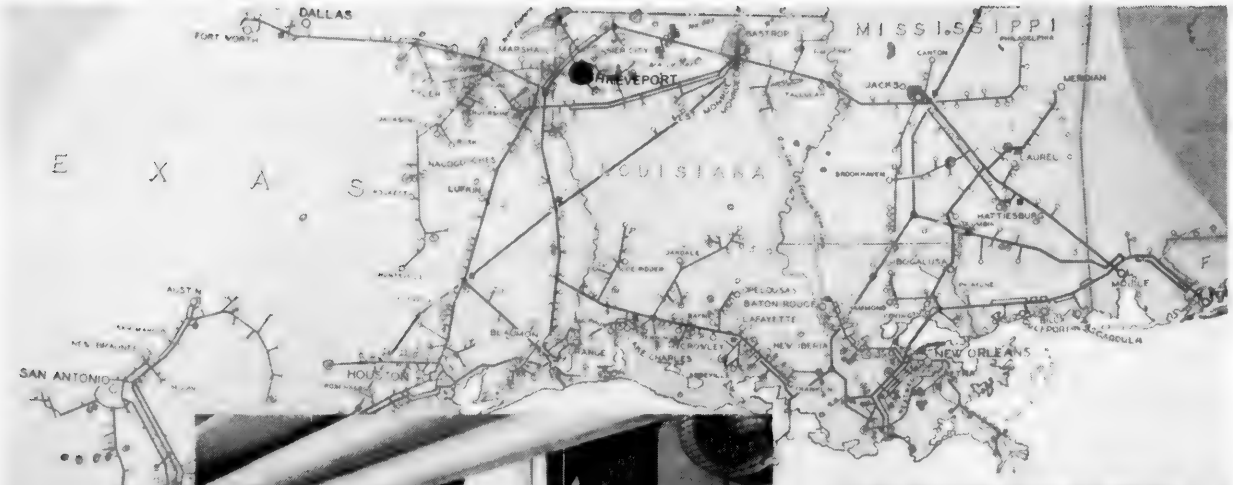
Don't be misled by outside similarity to Crane steel valves. Get the facts from your local Crane Representative or by writing to address below.

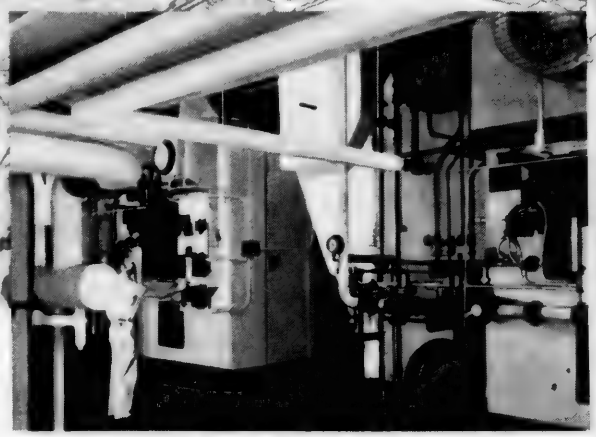


CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

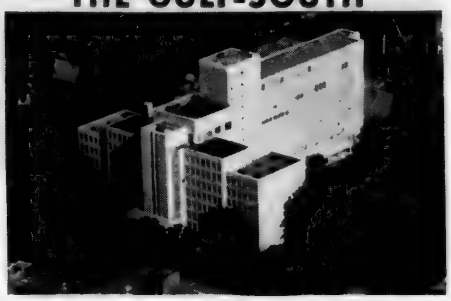
Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas





B&W FM units which provide steam for all requirements in the United Gas Building.

HELPING TO SERVE THE GULF-SOUTH



Headquarters for United Gas Corporation, the world's largest handler of natural gas.

B&W FM Boilers Provide Steam for AIR CONDITIONING • HEATING *United Gas Building*

United Gas Corporation and its subsidiaries of Shreveport, Louisiana, one of the largest systems of its kind in the world, supplies natural gas to a large and growing part of the southern section of the United States —the "Gulf South". And when the installation of modern heating and air conditioning facilities in the company's Shreveport headquarters building was being studied, the same careful consideration applying to other phases of the company's far flung operations was given to the selection of boilers. As other users have done, United Gas chose two B&W FM Units for a reliable and economical steam source.

In the newly enlarged United Gas Building, the FMs supply the heating load during the winter and steam for the much heavier summertime air-conditioning load. They are gas-fired and designed for manual or semi-automatic operation. Each boiler is designed to generate up to 11,000 lb of steam per hr at an operating pressure of 160 psi. Since their installation in August 1953, the FM Units have provided completely satisfactory service, efficiently and economically.

B&W FM Boilers are available in standard sizes to 40,000 lb of steam per hr at pressures to 235 psi. Many are also in service at higher pressures and with moderate superheat. Write for Bulletin G-76 for complete details. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-744

FMs Offer These COST-SAVING FEATURES

- Save Erection Time and Cost
- Meet Wide Range of Service
- Handle Quick Load Changes
- Suitable for Outdoor Service
- Safe, Automatic Operation
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burn Oil and/or Gas
- Save Fuel
- Save Space

BABCOCK & WILCOX

BOILER DIVISION

Good control is essential to good air conditioning performance. For years, the size of the big system has justified the expense of good conventional controls and a skilled supervising engineer. But what about smaller jobs—retail stores, theaters, supermarkets? Their day has come with electronics. The pioneer manufacturer of electronic controls for air conditioning tells why.

Electronics – new era in air conditioning

Honeywell Electronics gives non-technical business managers expert control of air conditioning—brings big-system convenience, economy to installations of any size.

Honeywell Electronics
Report Number Three

ENGINEERS and architects have suffered some nasty headaches trying to give the small-to-medium-sized job good air conditioning control at a reasonable price.

That picture has changed. For these jobs, the *best* control now can be specified: Honeywell Electronics.

There are many good reasons why electronic temperature control is of special value to the smaller building. One of them is simplicity.

Sensing element of the electronic thermostat, a Honeywell development, is a simple strand of wire. Yet it provides a means of sensing and correcting temperature changes quickly and accurately, without bulk, clumsy linkages or moving parts.

Such basic simplicity paves the way for the most desirable feature possible in small-system air conditioning—automatic operation, with its convenience, efficiency and economy.

With electronic temperature control the full capacity of the air conditioning equipment may be utilized automatically. This makes operation more *convenient:* the *same* thermostat may sequence from heating to full ventilation to mechanical cooling. Operation is more *economical:* automatic use of outside air to carry part of the cooling load does a lot to cut refrigeration costs.

Especially valuable for short-occupancy spaces such as retail stores is the faster, more accurate, more stable compensation that's achieved through electronics. It adjusts quickly for varying load changes; it also prevents discomfort from variations of wind and sun effects, or sudden changes in outdoor temperature.

Automatic winter-summer reset using an outdoor thermostat cures temperature drift in winter, air-cooling shock in the summer months. This means *consistent* comfort—in any kind of building, no matter what the weather does in any season.

Thus for the first time, thanks to electronics, the smaller building manager can have first-rate air conditioning control performance with simple, dependable equipment that he can operate himself.

The Electronic Control Center

Perhaps the single most valuable aspect of electronic temperature control in the smaller building is the electronic central control panel. These are Honeywell panels, each designed to meet the requirements of individual installations. They give the building manager advantages available in no other type of control installation at a comparable price.

Honeywell Electronic Air Conditioning Selector

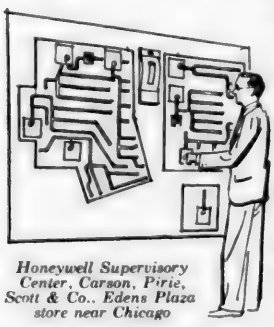
for smaller buildings

The simplest panel, the air conditioning selector illustrated above, gives a single non-technical man expert control of the building's heating and cooling equipment. At his fingertips, the store or office manager has the means for turning air conditioning on or off, for raising or lowering the temperature; for ventilating to meet exact needs.

Other Types

Another type of Honeywell panel is the Supervisory DataCenter for electronic control installations. An example is the one designed for a new suburban branch of Carson, Pirie, Scott & Co., Chicago department store.

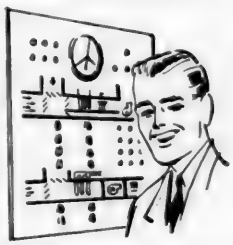
Like the air conditioning selector mentioned above, this panel allows space temperature to be selected from any convenient location. In addition, it contains a floor plan of the store; graphic representation of thermostat placement on all three floors; and temperature indication at each of the control points in the system—all shown on the panel. Yet it still may be operated by the non-technical building manager. A more sophisticated form of control is provided by the Honeywell three-zone Supervisory DataCenter in the Shreveport Club, Shreveport, Louisiana. Shown on the panel is a flow diagram of the air conditioning system, plus space temperatures; again, it allows one man complete control of the system, assuring a pleasant environment for all public areas and private rooms without an expensive technical staff.


Honeywell Supervisory Center, Carson, Pirie, Scott & Co., Edens Plaza store near Chicago

The Supervisory DataCenter

The benefits of electronic central control are by no means restricted to smaller installations. In huge modern buildings with full maintenance crews, a Honeywell Supervisory DataCenter, set up anywhere within the building, provides a focal point from which every vital function of the air conditioning system is checked and directed. Adjustments anywhere in the system may be made at the panel, reducing manpower needs and increasing efficiency.

Properly equipped with Honeywell instruments, the electronic Supervisory DataCenter can keep permanent performance records of heating and cooling components, assuring maximum fuel and power savings.


Honeywell three-zone Supervisory Center, Shreveport Club, Shreveport, La.

No specialist is needed for installing and servicing electronic controls. Wiring is low voltage, with standard color coding easily understood by any heating and air conditioning technician. Today's installations will be up-to-date for many years to come. Maintenance and equipment aging problems are minimized, because the electronic thermostat contains no moving parts.

Key Word: Flexibility

These advantages are summed up in one word: *flexibility*. It means that all or any combination of the electronic installation's features are readily adaptable to the solution of specialized control problems. The results are better, more efficient, more convenient operation of the air conditioning system—and important dollar savings.

In fact, it's *flexibility*—in the entire field of temperature control—that helps establish clearly Honeywell's leadership. For only Honeywell makes *all three types* of control systems: pneumatic, electric, electronic, each with distinctive advantages for certain applications. Thus only Honeywell is able, with complete objectivity, to help you select the one system shaped perfectly to the needs of the building and its occupants.

* * *

Ask for our new electronic control booklet which tells more fully how to apply electronics to your control problems. Write Honeywell, Dept. 1005, Minneapolis 8, Minn.

Minneapolis-Honeywell Regulator Company

Air conditioning keeps indoor climate clean, fresh, temperature-perfect at Norwich Pharmacal laboratory.

His comfort helps research improve your health

Here's how American Blower air conditioning equipment controls the climate in one of America's most modern research centers

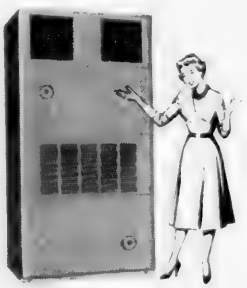
Having developed such antimicrobial agents as the nitrofurans – widely used in the treatment of both human and animal diseases, and comparable to the sulfonamides and antibiotics – the Norwich Pharmacal Company promises even greater aids to healthful living through improved research at its new Melvin C. Eaton Laboratory, Norwich, N. Y.

Here, American Blower air conditioning equipment assures ideal working comfort in offices and laboratories . . . eliminates variable temperatures in research projects.

For example, in work with rabbits – which are affected by fluctuations in heating or cooling – temperature changes could distort the results of many months' research. *Temperatures in the laboratory never vary more than one degree.*

Norwich's chief engineer, Wm. Agnew, adds: "Our American Blower equipment not only provides dependable, quiet air conditioning, it also does an excellent job of dust filtering – essential in keeping test tubes, test plates uncontaminated."

If your plans include air conditioning, it will pay you to talk to an American Blower sales engineer. Just call our nearest branch office. American Blower Corporation, Detroit 32, Michigan; Canadian Sirocco Company, Ltd., Windsor, Ontario.



In addition to equipment for complete central systems, American Blower offers packaged air conditioners for offices, stores, small industrial plants and similar applications.

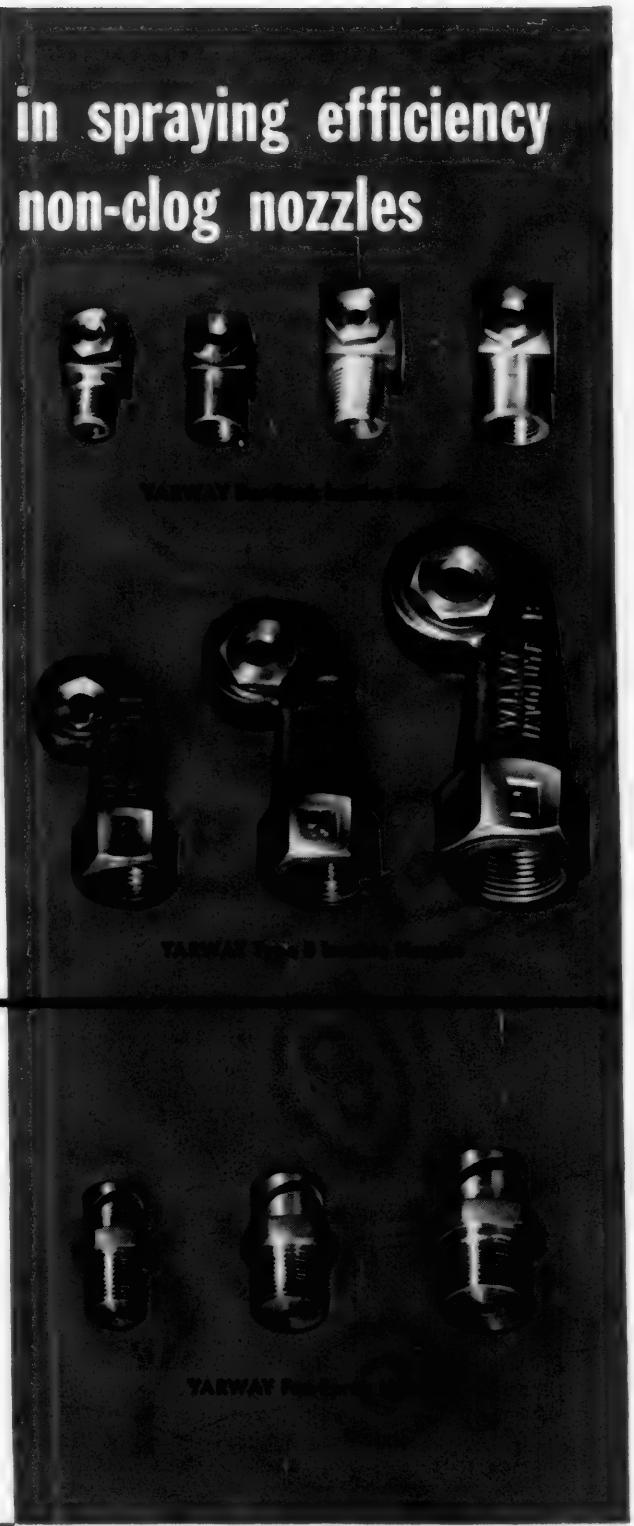
AMERICAN BLOWER

Division of American-Standard

Air conditioning equipment for every business

reach a new peak with YARWAY

in spraying efficiency non-clog nozzles



cone spray

Most popular design for cooling, recooling, washing, rinsing, air conditioning, drying and other spraying operations in industrial and processing work and in power plants.

Non-clog involute design has no internal parts (vanes or deflecting plates) on which foreign particles can collect. Special contour of nozzle body guides flow with minimum loss of energy towards discharge opening, where liquid attains maximum velocity and leaves nozzle in a fine hollow-cone spray.

Available in three types:

Bar-stock bronze (shown) for fine spray
Sizes ¼" and ⅜", male or female connection
Capacities up to 3 gpm; pressures 20 to 50 psi

Cast bronze Type B (shown) for air conditioning and small recooling systems
Five sizes, ½" to 1½"
Capacities up to 40 gpm; pressures 7 to 25 psi

Cast bronze Type C (not shown) for spray pond service
Sizes 2" and 2½"
Capacities up to 110 gpm; pressures 7 to 15 psi

Write for YARWAY Spray Nozzle Book N-617; it gives capacities, dimensions and application information.

fan spray

Preferred for many washing and cooling operations. Non-clog design, delivers flat fan-shaped sheet of spray with slicing action particularly desirable for surface washing.

Thin sheet of spray is discharged forward 30° from the vertical, spreading in fan shape up to 140°, depending on operating pressure.

Made of bronze, steel or other bar-stock metals, male thread, six sizes ⅛" to 1", capacities up to 7 gpm, pressures up to 50 psi.

Write for YARWAY Spray Nozzle Book N-617.

YARNALL-WARING COMPANY
104 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

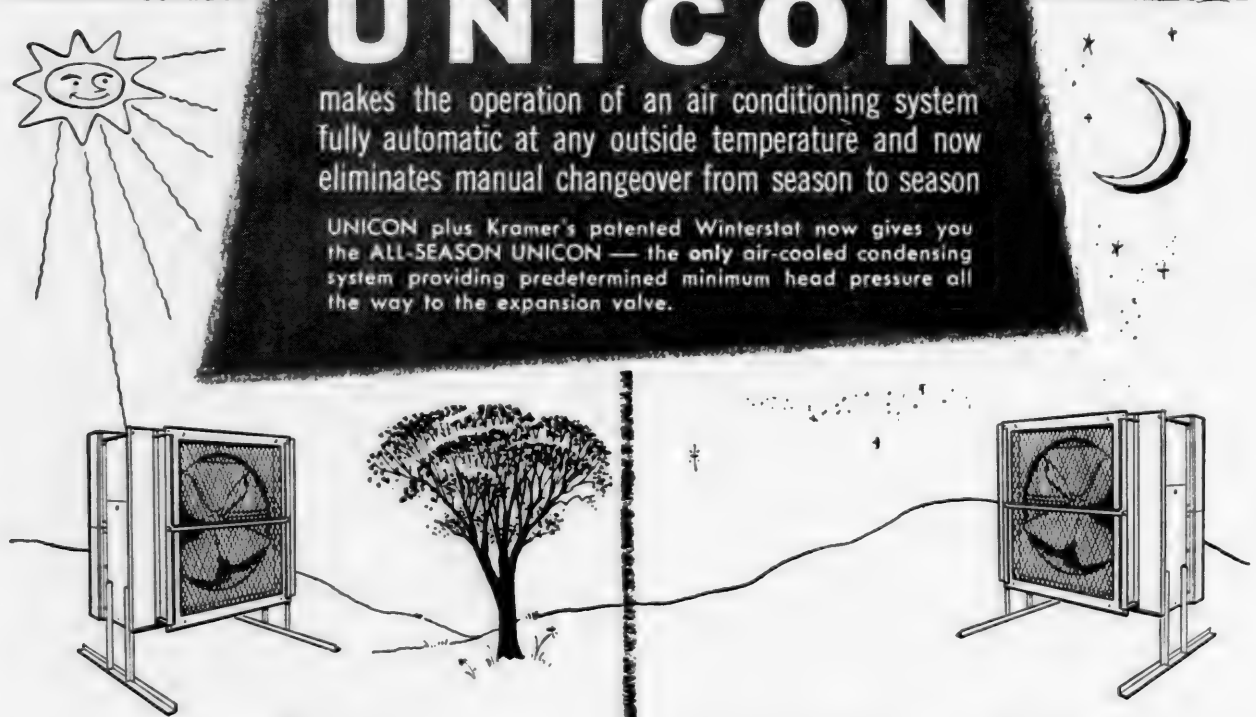
YARWAY spray nozzles

whether it's Summer . . . Winter

The ALL-SEASON WINTERSTAT with the KRAMER UNICON

makes the operation of an air conditioning system fully automatic at any outside temperature and now eliminates manual changeover from season to season

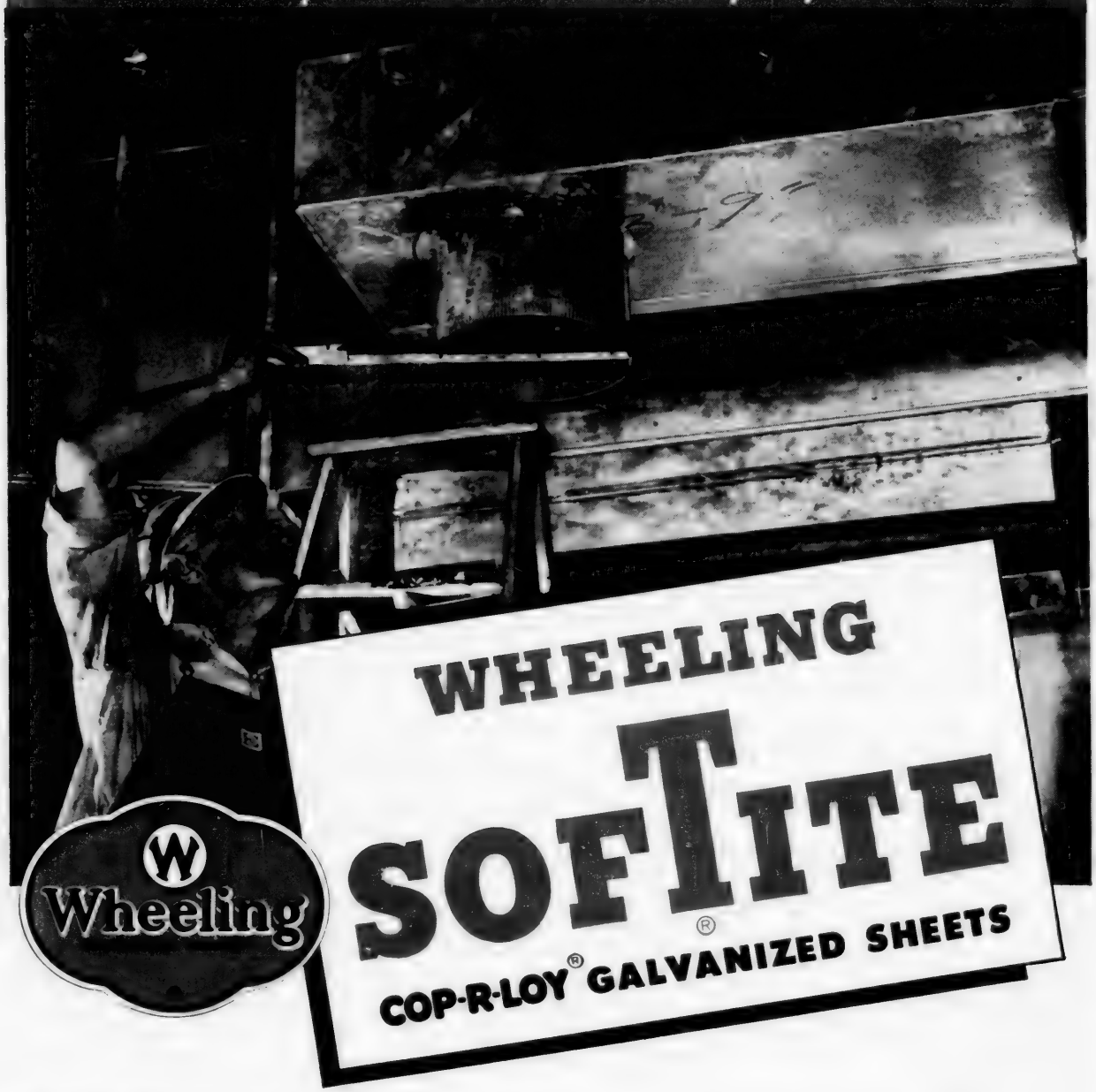
UNICON plus Kramer's patented Winterstat now gives you the ALL-SEASON UNICON — the **only** air-cooled condensing system providing predetermined minimum head pressure all the way to the expansion valve.



High Noon. . . or cool of evening

KRAMER TRENTON CO. • Trenton 5, N.J.

Meet the tightest-coated sheet yet produced!



Wheeling

WHEELING

SOFTITE®

COP-R-LOY® GALVANIZED SHEETS

This is Wheeling's Louisville warehouse. Other Wheeling warehouses and sales offices are strategically located throughout the country. They all offer immediate delivery of warehouse-stocked Wheeling items such as SOFTITE Cop-R-Loy Galvanized sheets, Galvanized Furnace Pipe, snap lock or closed seam Perimeter Heating or Air Conditioning Pipe, and accessories.

Think of the toughest test you can give a galvanized sheet. Then try it on a sheet of Wheeling SOFTITE. You've never seen anything like it. For here is a galvanized sheet that takes every roll, every bend, every crimp and fold without flaking or chipping its rugged coating. And for good reason. Because Wheeling SOFTITE Cop-R-Loy Galvanized Sheets have the tightest zinc coating yet produced.

What this means to you is tighter joints, surer seams, longer spans . . . jobs that look better, last longer, give utmost satisfaction.

Next time you order galvanized sheets, remember, only *Wheeling* makes SOFTITE and only SOFTITE has the tightest coating ever.

Get full details now. Write, wire or call the Wheeling warehouse or sales office nearest you.

WHEELING CORRUGATING COMPANY, WHEELING, WEST VIRGINIA

Warehouses: Boston, Buffalo, Chicago, Columbus, Detroit, Kansas City, Louisville, Minneapolis, New Orleans, New York, Philadelphia, Richmond, St. Louis. **Sales Offices:** Atlanta, Houston.

LINE UP *for* *with* SPORLAN

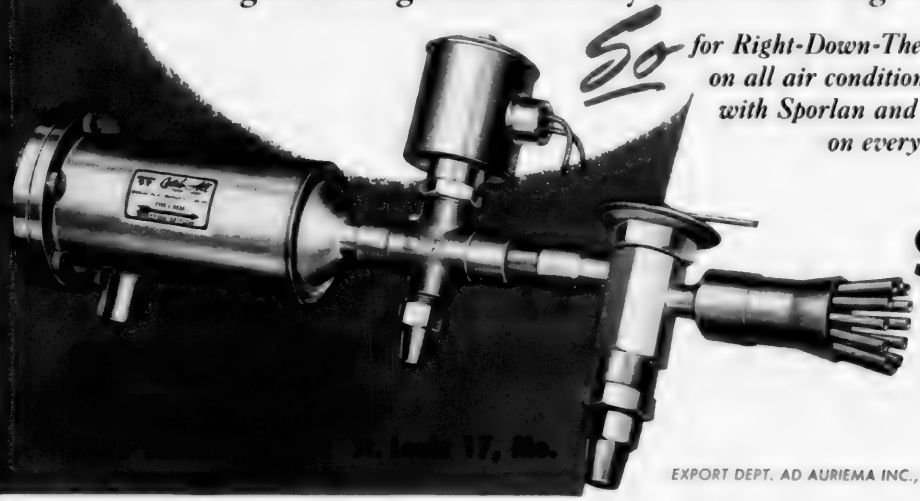
No matter how large or small the system, there's a perfect Sporlan hook-up available from Catch-All to Distributor

Everyone knows about Sporlan Catch-Alls, the perfect Filter-Driers. They assure you filtering instead of straining. Dirt-free, sludge-free systems are the result. Harmful corrosive acids are adsorbed and retained. In addition, they dry down to an end point so low that any remaining moisture is absolutely harmless.

The new Sporlan Solenoid Valves offer even greater Peak Performance with the new power-packed Blue Seal Coil. No more worries over electrical failures. They're really tight closing, too!

Sporlan Thermostatic Expansion Valves with the exclusive Flow-Master element, are your guarantee against hunting. Alternately starved and flooded evaporators will never plague you again with these Peak Performers!

Uniform distribution to all circuits are yours with Sporlan Peak Performance Distributors. Their perfectly designed conical button and interchangeable nozzles give them greater flexibility and a much larger range of application.



So for Right-Down-The-Line Peak Performance on all air conditioning systems... Line up with Sporlan and get Peak Performance on every installation.

SPORLAN

St. Louis 17, Mo.

EXPORT DEPT. AD AURIEMA INC., 89 BROAD STREET, NEW YORK 4, N. Y.

For lowest cost steam, KVP Company burns coal the modern way

The engineering department of the Kalamazoo Vegetable Parchment Company, following an extensive fuel survey, decided to meet increased power demands by burning coal the modern way.

Five of eight existing coal fired boilers of varying age were replaced by one new boiler capable of burning a diversified range of coals. In addition, automatic coal handling equipment was installed. With it, coal is automatically dumped, magnetically cleaned, carried to the power house by a moving belt, crushed, pulverized and fed into the furnace.

These new facilities have resulted in increased steam capacity, lower operating costs and lower fuel costs.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

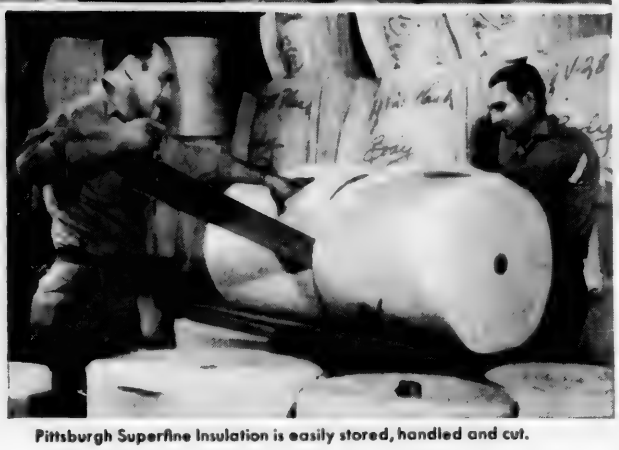
Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Valley Forge cut production time and reduced costs with Pittsburgh Superfine Fiber Glass Insulation. Two employees are applying insulation to boiler jackets. Superfine reduces weight factor of finished product.



Pittsburgh Superfine Insulation is easily stored, handled and cut.

"PITTSBURGH SUPERFINE has definitely increased our output"

—says Mr. Paul Fusco, Plant Manager

Valley Forge Metals Division of Nicolet Industries, Inc. Lansdale, Pennsylvania

"It used to take four men two to three days to insulate 400 boiler jackets when we used another type of insulation. Today, using Pittsburgh Superfine Fiber Glass Insulation, four men do the same job in about a day and a half!" reports Mr. Fusco.

When Valley Forge, a fabricator of boiler jackets, baseboard radiation units, and gas, electric and hot water units, switched to Pittsburgh Superfine Insulation, they immediately gained many operating advantages.

With lightweight Superfine, Valley Forge shortened time required to cut insulation for boiler jackets. Insulation application time was reduced 20% since Superfine is held in place with adhesive; this change eliminated a clip-fabricating and spot-welding operation, and reduced spoilage to zero.

"Superfine is flexible, readily follows jacket radii and covers the product more easily," stated Mr. Fusco. "It has a higher insulating value for boiler jackets, too. Its lightweight characteristics make it easy to handle and it reduces the weight of the finished product as much as 20 to 30 pounds, saving on shipping and it helps us keep the plant clean."

LET PITTSBURGH SUPERFINE HELP YOU, TOO!

Pittsburgh Superfine is composed of extremely fine glass fibers and is a lightweight, efficient thermal and acoustical insulating material . . . ideal for controlling heat or cold and absorbing sound.

If you have insulating problems, Pittsburgh Superfine may be your answer. Why not call us for consultation? *Fiber Glass Division, Pittsburgh Plate Glass Company, One Gateway Center, Pittsburgh 22, Penna.*

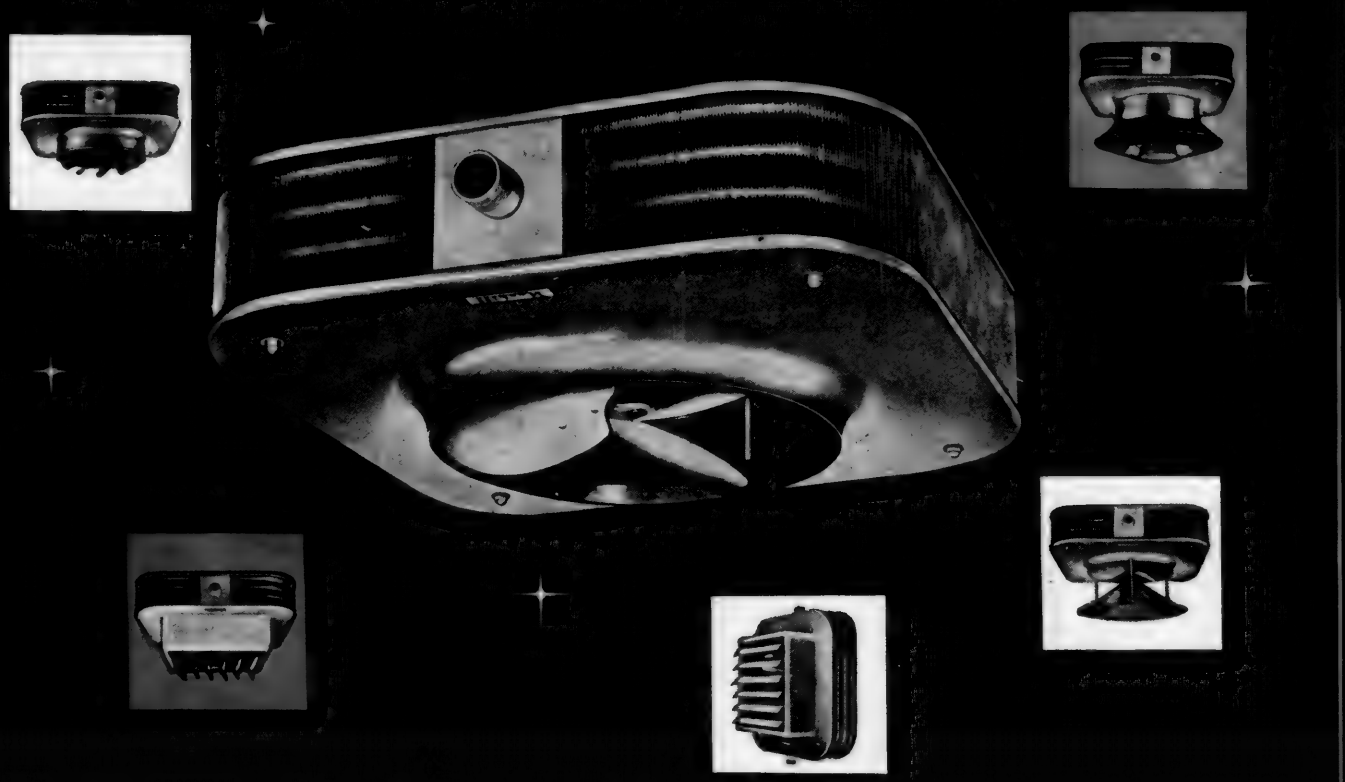
PITTSBURGH SUPERFINE IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte Chicago Cincinnati, Cleveland Detroit, Houston, Los Angeles, New York, Philadelphia and St. Louis

FIBER PG GLASS **PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS**

PITTSBURGH PLATE GLASS COMPANY

New Design ... New Features



the all new Nesbitt Little Giant unit heaters

One heating element operates on steam or hot water in both vertical and horizontal applications. Wrap-around rectangular construction increases heat transfer area. Opposing headers mean shorter tubes and condensate travel, assuring more even heating on steam systems.

Closer-to-ceiling mounting permitted by side-located piping connections. Motor on all models is removable through botton fan outlet, eliminating the need for access space above the unit. Maximum headroom is assured.

Wide variety of outlets (Adjustable Vane, Cone Deflector, Anemostats and Horizontal- or Vertical-Louvred) simplifies selection of the discharge patterns and mounting heights best suited to the job requirements.

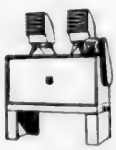
Larger capacity range (34,000 to 684,000 Btu per hour) and smaller physical size permit the economical use of these "propeller fan unit heaters with blower fan performance" in all types of industrial and commercial buildings.

IUHA Rated for Sound and Capacity. All 34 models are sound rated according to today's most reliable basis for judging sound emission. You may now select Little Giants sound coded for the environment they serve.

Little Giant Unit Heaters are tested and rated in accordance with the Standard Test Codes adopted jointly by the Industrial Unit Heater Association and the American Society of Heating and Air Conditioning Engineers.

Send today for Nesbitt Publication 402.

Other Nesbitt Unit Heaters



GIANT UNIT Pub. 404

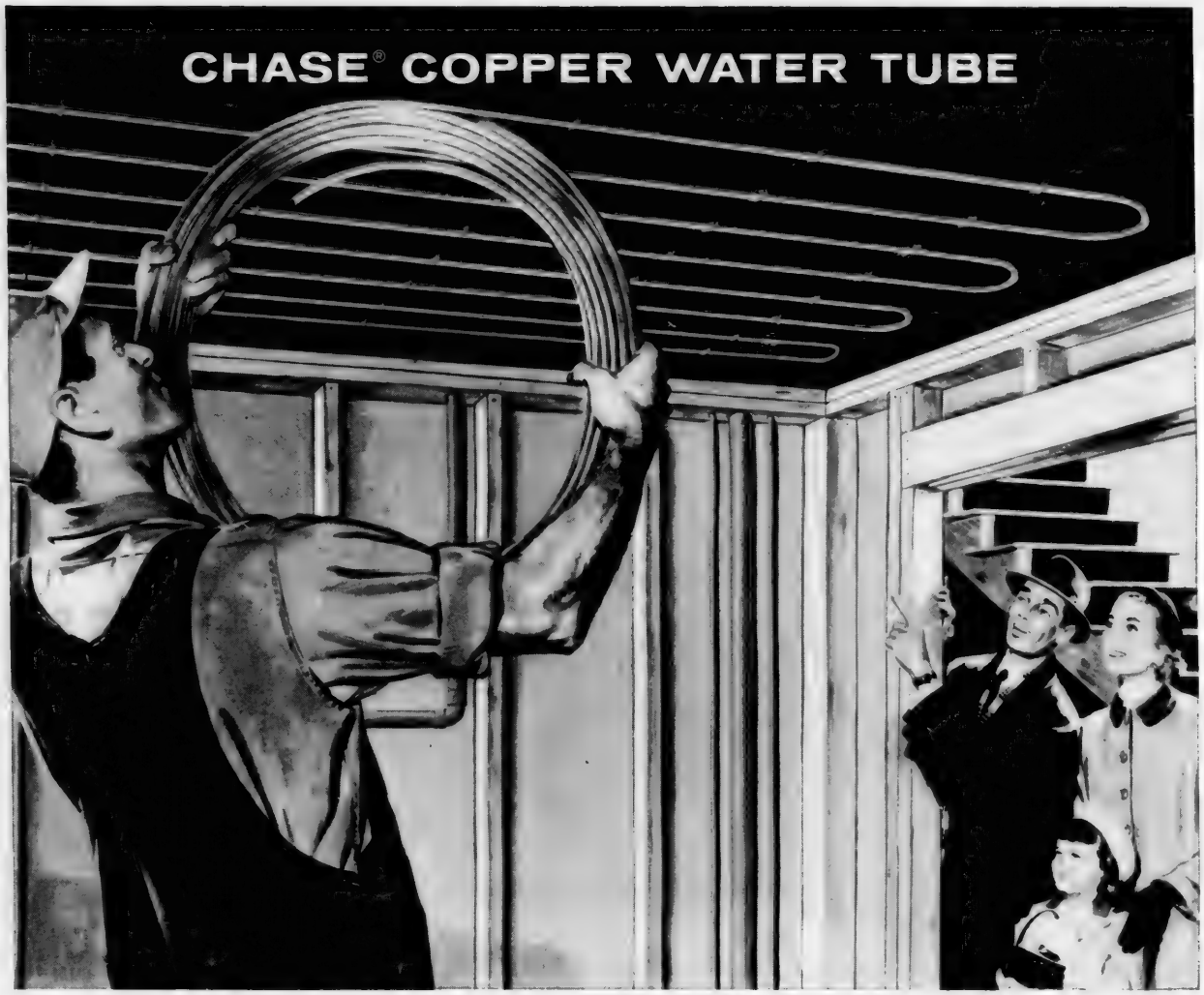
PROPELLER FAN Pub. 401

GAS-FIRED Pub. 280

SERIES C Pub. 403

Nesbitt Unit Heaters are made and sold by
John J. Nesbitt, Inc., Philadelphia 36, Pa.

Nesbitt
LITTLE GIANT UNIT HEATERS



NO CEILING ON COMFORT HERE !

But, plenty of ceiling on cost!

That's because lightweight, easy-handling Chase copper tube for radiant heating *installs faster!* Perfectly tempered, it easily unrolls into position on ceiling or floor. Comes in long 60 and 100-foot lengths that result in fewer joints. Connections are quickly made with simple soldering techniques.

Even the rugged carton for Chase copper water tube is designed to speed handling... save time! It's color-coded for easy identification of type and size. Has a center hole big enough for a firm grip. Can be stacked, rolled or carried with ease!

Proof that Chase copper water tube cuts installation time is the fact that it is being used in many of the largest housing developments where over-all costs *must be low!*

If it's radiant heating, be sure the system is made with Chase copper tube and solder-joint fittings.

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

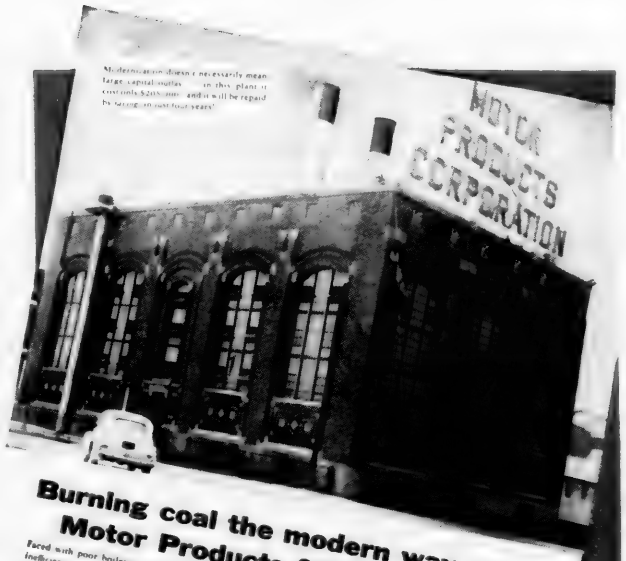
Detroit RotoStokers Type C-C —Important in Savings by this Modernization Award Winner

Motor Products Corporation, Detroit, won a "Power" Modernization Award with a program in which Detroit RotoStokers, Type C-C played an important part. Savings will pay for the investment in four years.

The Type C-C is a spreader stoker that automatically cleans the fuel bed and discharges the ash continuously at the front. It operates without smoke through a wide load range — important to a plant located in the midst of a city, such as Motor Products Corporation.

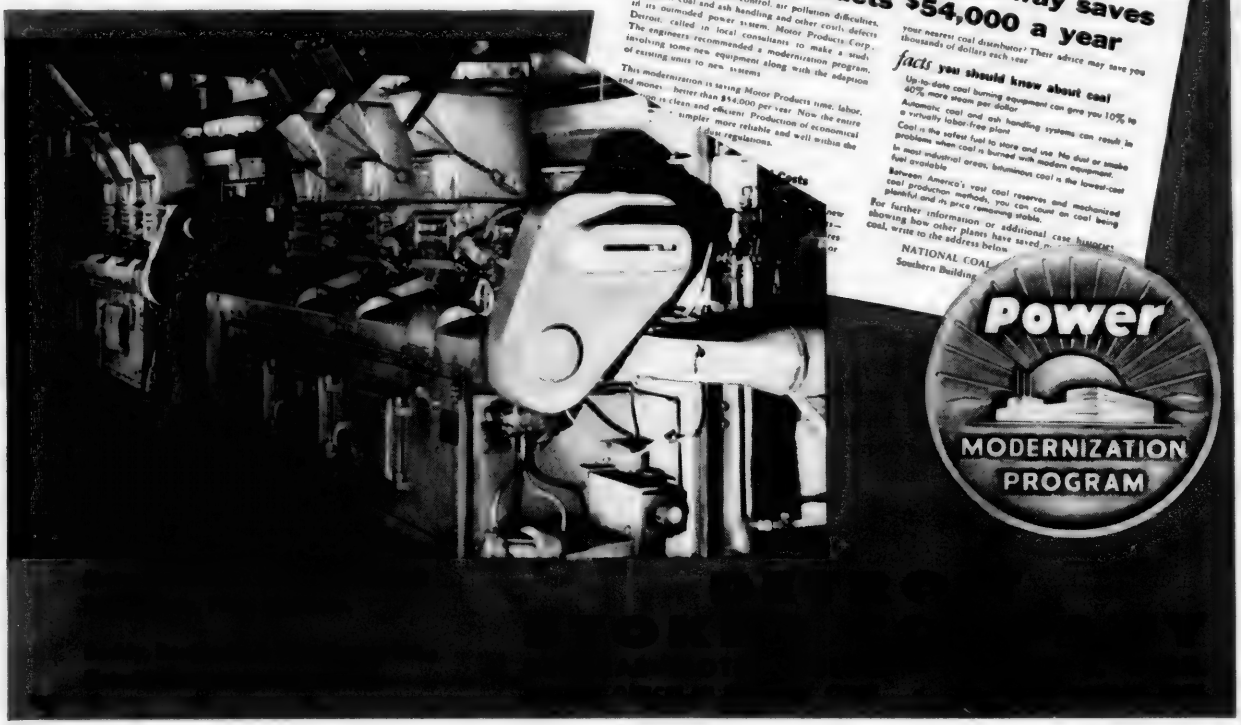
Let us tell you more about the economies available with Detroit RotoStoker, Type C-C.

Write for Bulletin — No Obligation.



Burning coal the modern way saves Motor Products $54,000 a year

facts **you should know about coal**



Power
MODERNIZATION
PROGRAM

Jobs like this are better with Bethcon

They're readying some ductwork for the ventilating system of a new auditorium. Those units were fabricated from Bethcon galvanized sheet steel, which gives them an edge over similar sheet-metal ducts of only two or three years ago.

That edge stems from the fact that Bethcon is Bethlehem's *continuously* galvanized sheet. Bethlehem's continuous galvanizing imparts certain improvements to the sheet, which in turn make for better sheet-metal jobs.

Chief advantage of Bethcon is the superior bond between zinc coating and base metal. This lets you put Bethcon sheets through severe forming processes—even to bending it double—without cracking or peeling of the zinc.

The coating is more uniform, too, both in thickness and in appearance. The center and ends of Bethcon sheets all get equal coating weight and equal protection, and there is no bead along the drip end. Spangles are brighter and more attractive.

You can get Bethcon in cut sheets or coiled strip, 14-gage or lighter. Either plain carbon or corrosion-resisting Beth-Cu-Loy (copper-bearing steel) can be used for the base metal, depending on your requirements. For further information, just put in a call or write a note to the Bethlehem district sales office nearest you.

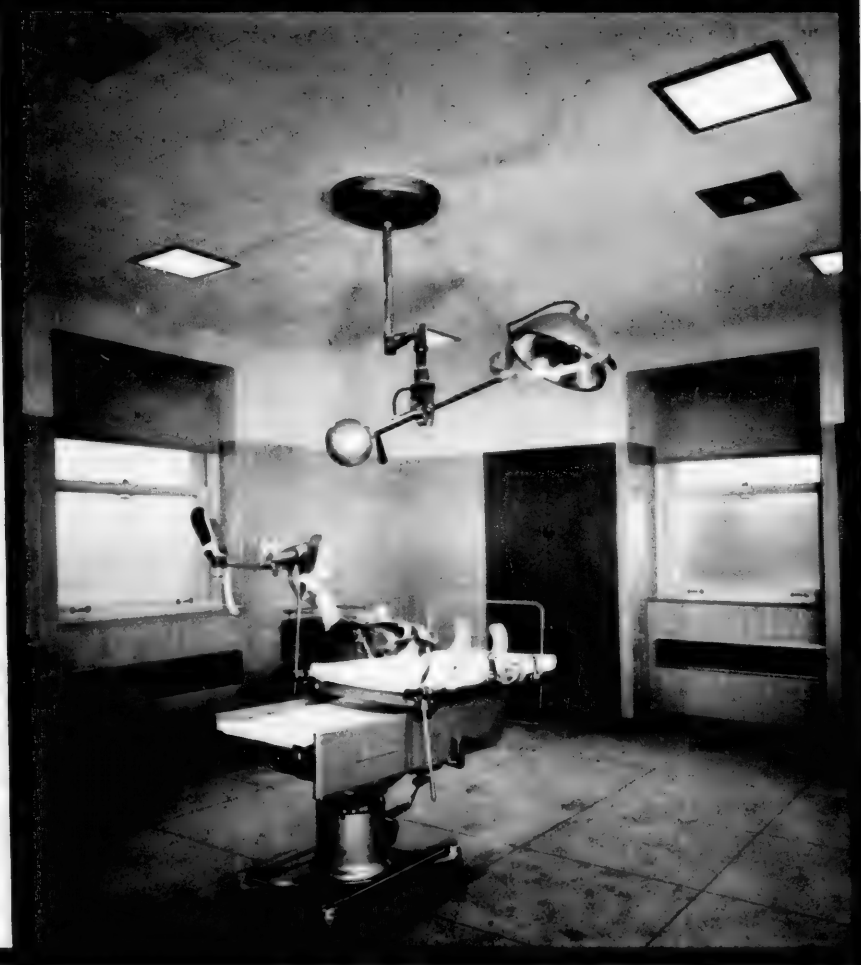
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Photos: A. R. Gilbert



▲ To provide draftless air diffusion in the delivery room, All-Air High Velocity units are placed under the window. High velocity sound attenuation chambers with square diffusers are mounted in the ceiling. *Turn page for detail.*

▼ In the nursery for premature infants, sound attenuation chambers with square air diffusers are mounted in the ceiling. *Turn page for detail.*

A new high in

high velocity for hospitals

New wing of Abington Memorial Hospital, Abington, Pa.

Architects & Engineers:
Jack Steele Company, Philadelphia, Pa.
Schmidt, Garden & Erikson, Chicago, Ill.

Air Conditioning Contractors:
Huffman-Wolfe Company, Philadelphia, Pa.
Paul A. Norair, Washington, D. C.

▲ All-Air High Velocity under-the-window units are used in all private and semi-private patients' rooms. *Turn page for detail.*

Here are shown applications of the Anemostat All-Air High Velocity air distribution system in the new wing of the Abington Memorial Hospital.

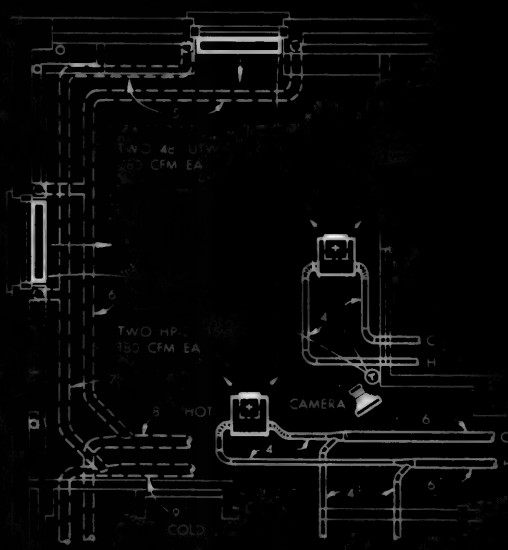
The trend towards Anemostat All-Air High Velocity Systems is growing rapidly. The Anemostat All-Air High Velocity air distribution system can be used with smaller than conventional ducts. It can be installed faster and at less cost. It requires no coils, thus eliminates leakage, clogging and odors. These units save space when installed in hospitals, office buildings, department stores, banks, schools, factories and other structures.

ARCHITECTS—Attention Please:

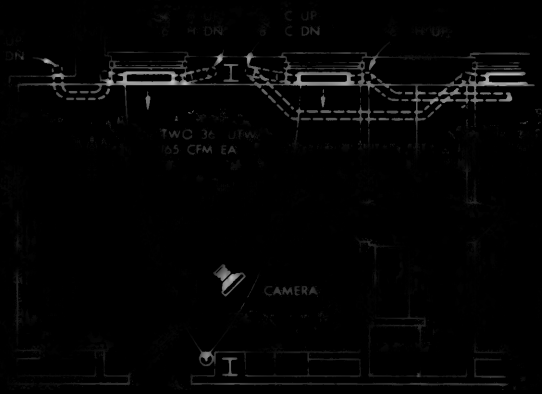
Anemostat round, square and straightline diffusers with high velocity units complement a wide variety of architectural designs.

Write on your business letterhead for 1956 New Products Bulletin and Selection Manual 50

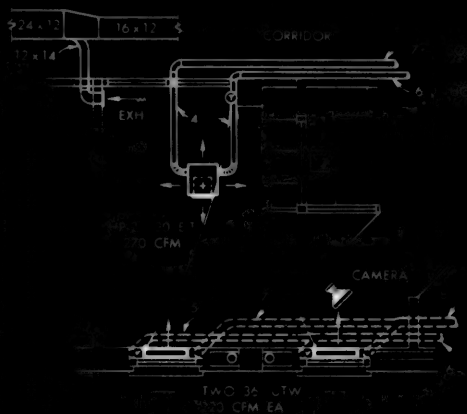
Delivery room



Patients' room



Premature Nursery



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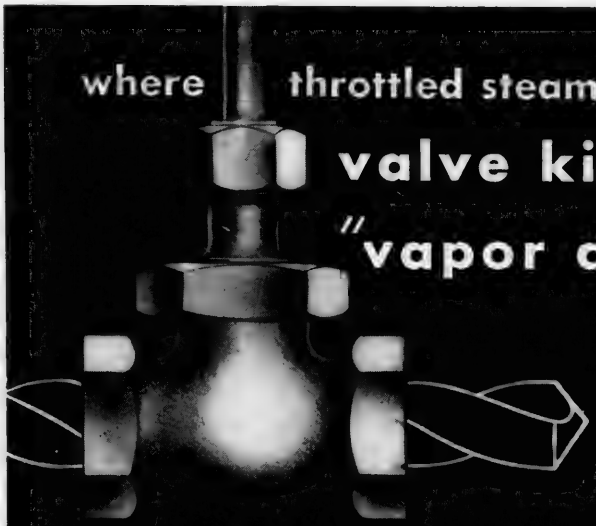
AC 1339

where throttled steam is a valve killing "vapor drill"



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with the

500 BRINELL

STAINLESS STEEL ARMOR SEAT

will lower costs

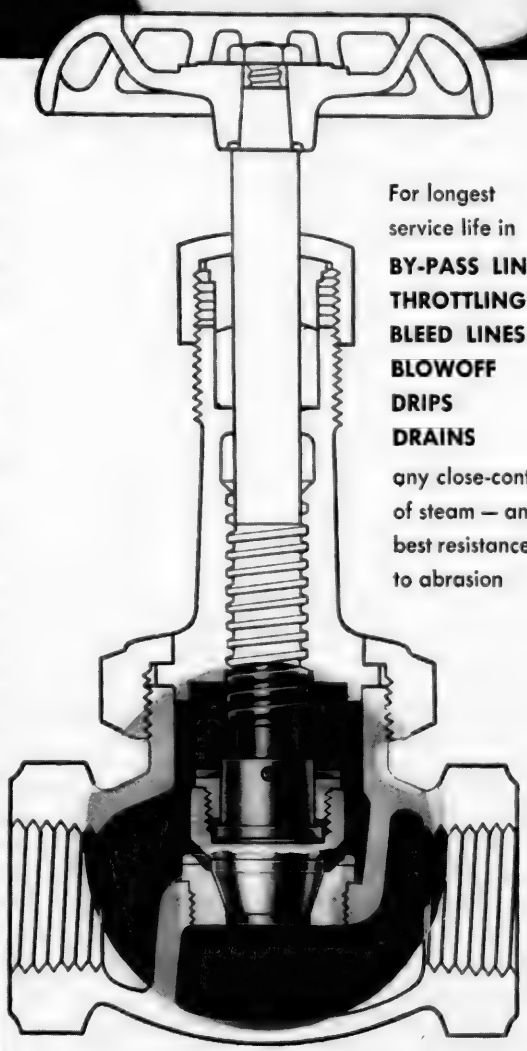
Closely regulated steam erodes grooves in seating units and drastically cuts service life of ordinary valves.

Jenkins Plug Type Valves have been engineered in every detail for maximum wear in such valve-killing service. The stainless steel Armor Seat defies the "vapor drill", and Jenkins quality throughout gives them top rating for wear-proof and trouble-proof perfomance.

Make you own test . . . in your toughest steam service . . . or anywhere that abrasion or erosion causes frequent valve failure. Compare, part for part, with any similar valve. You'll find that, again, Jenkins *extra value* pays off in longer life and lower maintenance cost.

Plug and seat ring are Jenkins JX500, a Stainless chromium alloy steel made to Jenkins high strength specifications, heat-treated to 500 Brinell. Seating surfaces are super-hard and mirror-smooth, offer highest resistance to galling, cutting, abrasion, and erosion. Wide, steep, 30° total taper permits extremely close regulation of flow and vapor-tight closure.

The Stainless steel plug is securely fastened to the spindle with a bronze locknut. Spindle is Jenkins specification bronze with a tensile strength exceeding 60,000 lbs., — has high corrosion resistance.



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Jenkins Bros

New headquarters building of Rotary International at Evanston, Illinois

Wagner Motors provide quiet circulating pump power at new headquarters of Rotary International

Electric motors that drive heating system pumps need plenty of electrical and mechanical stamina to hold up under the hard, steady grind expected of them. And, they must be unusually quiet, too. Wagner Motors assure this kind of reliable service—and quiet operation.

That's why Bell & Gossett Company, manufacturers of Hydro-Flo Circulating Pumps, chose Wagner Motors for their Universal Pumps used in the new Rotary International Headquarters at Evanston, Illinois.

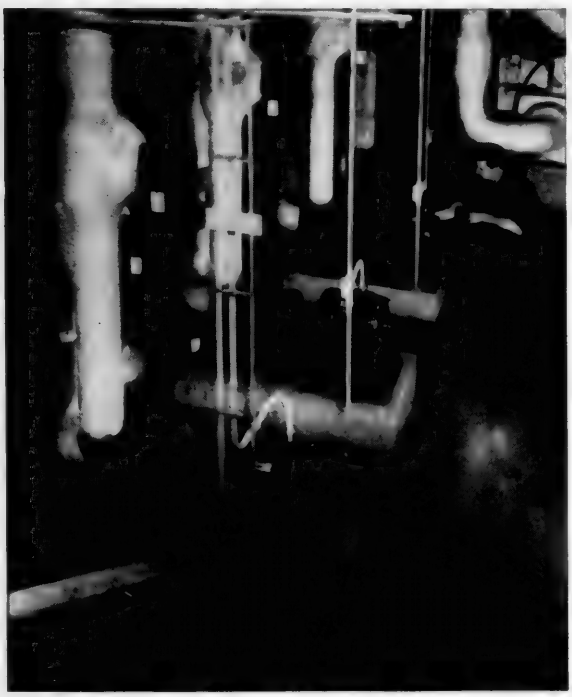
Part of this installation is shown at right. The motors in the foreground are 7½ horsepower, quiet-type Wagner Polyphase Motors, especially selected for smooth balance and quiet operation. The other motors in this installation are standard, resilient mounted 5 horsepower Wagner Polyphase Motors.

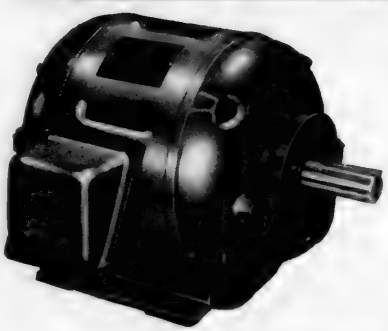
Here's where you can take a tip from Bell & Gossett... when you need dependable, *quiet* motors—5 horsepower or below—choose Wagner resilient mounted *standard* motors.

They are available with resilient bases in both sleeve and ball bearing types. You save money—and get the quiet operation that only a specially selected or resilient mounted motor can give.

Perhaps you have a specialized motor application... if so, remember, there's a Wagner motor to fit every need ...a complete line for all current specifications with a wide variety of enclosure types and mountings.

Your nearby Wagner engineer can help you select the *right* motor to meet your specifications. Call the nearest of our 32 branch offices or write us.





These Wagner standard motors, in ratings up through 5 horsepower, can be used for specialized applications because they are available in sleeve bearing or ball bearing models with rigid or resilient mounts.

Wagner Electric Corporation
6463 Plymouth Ave., St. Louis 14, Mo., U.S.A.

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ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

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For Your Fact File!

COMPARATIVE REFRIGERANT CHARACTERISTICS OF genetrons® AND OTHER BASIC REFRIGERANTS

(PERFORMANCE BASED ON 5°F EVAPORATOR TEMPERATURE AND 86°F CONDENSER TEMPERATURE)

	genetron 11 Trichloro-monofluoro-methane	genetron 12 Dichloro-difluoro methane	genetron 141 Monochloro-difluoro methane	genetron 226 Trichloro-trifluoro-ethane	Carrene 7	Methyl Chloride	Ammonia	Sulfur Dioxide
Chemical Formulae	CCl_3F	CCl_2F_2	$CHClF_2$	$C_2Cl_3F_3$	Note 1	CH_3Cl	NH_3	SO_2
Molecular Weight	137.4	120.9	86.5	187.4	99.3	50.5	17.0	64.1
Boiling Pt. (°F) at 1 Atmosphere Pressure	74.7	−21.6	−41.4	117.6	−28.0	−10.8	−28.0	14.0
Evaporator Pressure at 5°F (p.s.i.g.)	24.0*	11.8	28.3	27.9*	16.4	6.5	19.6	5.9*
Condensing Pressure at 86°F (p.s.i.g.)	3.6	93.2	159.8	13.9*	113.4	80.0	154.5	51.8
Freezing Point (°F) at 1 Atmosphere Pressure	−168	−252	−256	−31	−254	−144	−108	−104
Critical Temperature (°F)	388	233	205	417	221	289	271	315
Critical Pressure (p.s.i. absolute)	635	582	716	495	631	969	1657	1142
Compressor Discharge Temperature (°F)	112	100	131	86	105	172	210	191
Compression Ratio (86°F/5°F)	6.24	4.07	4.06	8.02	4.12	4.48	4.94	5.63
Saturated Liquid Viscosity at 5°F (centipoises)	0.650	0.328	0.286	1.200	—	0.293	0.250	0.503
Saturated Liquid Viscosity at 86°F (centipoises)	0.405	0.251	0.229	0.619	—	0.234	0.207	0.281
Vapor Viscosity at 5°F & 1 Atmosphere Pressure (centipoises)	0.0096	0.0114	0.0114	0.0093†	—	0.0095	0.0085	0.0111
Vapor Viscosity at 86°F & 1 Atmosphere Pressure (centipoises)	0.0111	0.0127	0.0131	0.0105†	—	0.0109	0.0102	0.0131
Saturated Liquid Density at 5°F (lbs./cu.ft.)	97.88	90.00	83.34	103.20	80.11	61.65	41.11	92.00
Saturated Liquid Density at 86°F (lbs./cu.ft.)	91.38	80.63	73.36	96.96	71.23	56.24	37.16	84.44
Saturated Vapor Density at 5°F (lbs./cu.ft.)	0.0815	0.6735	0.8034	0.0370	0.657	0.2237	0.1227	0.1558
Saturated Vapor Density at 86°F (lbs./cu.ft.)	0.4461	2.569	3.213	0.2569	2.598	0.9253	0.5643	0.8440
Specific Volume of Saturated Vapor at 5°F (cu.ft./lb.)	12.27	1.49	1.25	27.04	1.52	4.47	8.15	6.42
Latent Heat of Vaporization at 5°F (B.t.u./lb.)	84.0	69.5	93.6	70.6	—	180.7	565.0	169.4
Net Refrig. Effect of Liquid (86°F/5°F) (B.t.u./lb.)	67.5	51.1	69.3	53.7	61.1	150.2	474.4	141.4
Specific Heat of Liquid at 86°F (B.t.u./lb. °F)	0.21	0.24	0.34	0.22	—	0.39	1.14	0.39
Specific Heat of Vapor at Constant Pressure of 1 Atmosphere & 86°F (B.t.u./lb.°F)	0.13	0.15	0.15	0.15	—	0.24	0.51	0.15
Specific Heat Ratio at 86°F & 1 Atm. (k=Cp/Cv)	1.14	1.14	1.18	1.09	—	1.20	1.32	1.29
Coefficient of Performance	5.09	4.70	4.66	4.92	4.61	4.90	4.76	4.87
Horsepower/Ton Refrigeration	0.927	1.002	1.011	0.960	1.022	0.962	0.989	0.968
Refrigerant Circulated/Ton Refrig. (lbs./min.)	2.96	3.92	2.89	3.73	3.27	1.33	0.422	1.41
Liquid Circulated/Ton Refrig. (cu.in./min.)	56.0	83.9	68.0	66.5	79.3	40.9	19.6	28.9
Compressor Displacement/Ton Refrig. (c.f.m.)	36.32	5.81	3.60	100.76	4.97	5.95	3.44	9.09
Thermal Conductivity of Saturated Liquid at 32°F (B.t.u.ft./ft.²hr. °F)	0.0680	0.0559	0.0704	0.0576	—	0.103	0.29	0.122
Thermal Conductivity of Saturated Liquid at 86°F (B.t.u.ft./ft.²hr. °F)	0.0609	0.0492	0.0595	0.0521	—	0.089	0.29	0.111
Thermal Conductivity of Vapor at 32°F & 1 Atm. Pressure (B.t.u.ft./ft.²hr. °F)	0.0045	0.0048	0.0060	0.0038‡	—	0.0053	0.0128	0.0050
Thermal Conductivity of Vapor at 86°F & 1 Atm. Pressure (B.t.u.ft./ft.²hr. °F)	0.0048	0.0056	0.0068	0.0045‡	—	0.0065	0.0145	0.0056
Stability (Toxic Decomposition Products)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Toxicity (Underwriters' Laboratories Group No.)	5A	6	5A	4-5	5A	4	2	1
Flammability	None	None	None	None	None	Yes	Yes	None
Relative Dielectric Strength of Vapor (compared with Ethyl Chloride as Unity)	3.00	2.40	1.31	2.60	—	1.06	0.82	1.90
Odor	Ethereal	Ethereal	Ethereal	Ethereal	Ether.	Ether.	Acrid	Acrid
Type of Compressor in Which Usually Used	Cen.	All	Rec-Rot	Cen.	Rec-Rot	All	All	Rec.
Evaporator Temperature Range, °F	−20 to 50	−100 to 50	−125 to 50	−25 to 50	−100 to 50	−80 to 50	−90 to 20	−60 to 50
Water Sol. in Liq. Refrig. at 32°F (gms./100 gms. Refrig.)	0.0036	0.0026	0.060	0.0036	—	0.026 at −10°F	High	High
Water Sol. in Liq. Refrig. at 86°F (gms./100 gms. Refrig.)	0.013	0.012	0.15	0.013	—	—	High	High
Oil Solubility (Miscibility With Lubricating Oils)	Yes	Yes	Partial	Yes	Yes	Yes	No	No

*Inches of mercury vacuum †At. 0.1 atmosphere ‡At. 0.5 atmosphere

Note 1. Carrene 7 is an azeotropic mixture of Genetron 100(CH_3CHF_2) and Genetron 12(CCl_2F_2)

Genetron Super-Dry Refrigerants are available from Refrigeration Wholesalers throughout the country.

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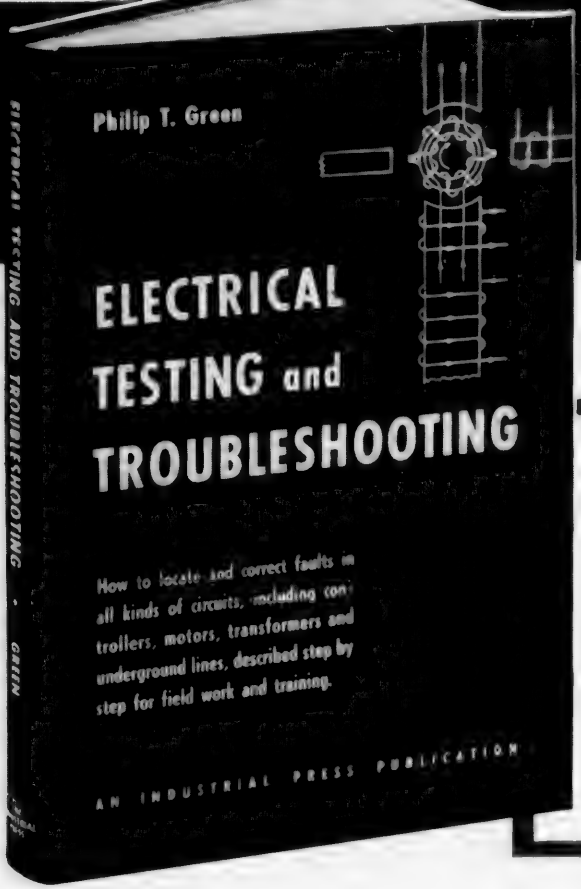
Philip T. Green
ELECTRICAL TESTING and TROUBLESHOOTING
How to locate and correct faults in all kinds of circuits, including controllers, motors, transformers and underground lines, described step by step for field work and training.
AN INDUSTRIAL PRESS PUBLICATION
ELECTRICAL TESTING AND TROUBLESHOOTING · GREEN

HERE ARE SIMPLE, STRAIGHT-FORWARD PROCEDURES FOR ELECTRICAL TESTING AND TROUBLESHOOTING —PROCEDURES THAT HAVE BEEN PROVEN IN PRACTICAL FIELD TESTS.

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CHAPTER 14. BARING LUBRICATION
- Sound
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ELECTRICAL TESTING and TROUBLESHOOTING

Simple, straightforward, *tested* procedures for electrical troubleshooting are now brought to you by an expert in ELECTRICAL TESTING AND TROUBLESHOOTING. These procedures are explained so clearly that this book will prove extremely useful as a training text as well as a working manual for practicing electricians and others concerned with the use and maintenance of electrical equipment. Examine the table of contents at the left and you'll see its thorough coverage. You'll find your own problems greatly simplified when you have this book to guide you.

Covers All These Subjects

This book shows you how to locate and correct faults in circuits of all kinds, including—controllers, motors, transformers and transmission lines. A simplified briefing on electrical symbols and diagrams is followed by detailed discussions of these topics:

- Analyzing and charting controller operation
- Insulation testing
- Electromagnet windings
- Single phase transformers
- Polyphase transformers
- Synchronous motors
- Troubleshooting test equipment
- Locating grounds
- D.C. machine windings
- Phase sequence
- Induction motors
- Power cable faults
- Bearing Lubrication

References to applicable codes and standards are included for each subject treated.
From the standpoint of personnel safety, another outstanding feature of the book is that most of the tests are performed with the equipment isolated from the power line. Current in these tests is supplied by dry cells or residual magnetism, so that accidental contact and short circuits are less hazardous to both men and machines.

About the Author

Philip T. Green, the author of ELECTRICAL TESTING AND TROUBLESHOOTING, is Industrial Training Coordinator of the Panama Canal Zone Company. He has been associated with this organization since 1937. Previously he had been a Teaching Fellow at the University of Cincinnati, where he received both his B.S. and M.S. degrees in Electrical Engineering. In addition to his background in industrial training and electrical engineering, the author has also served as educational advisor to units of the International Brotherhood of Electrical Workers.

Tested, Timesaving Procedures

All of the troubleshooting procedures described have been tested in the field and proven to be great time-savers—especially for locating obscure sources of trouble. And you'll find a mere basic knowledge of simple arithmetic sufficient for you to understand and use these procedures. The author's teaching experience has enabled him to arrange the entire book in easily understandable units. When you examine ELECTRICAL TESTING AND TROUBLESHOOTING, you'll agree it's one of the most useful books yet published on the subject. The coupon below makes it easy for you to order your copy now!

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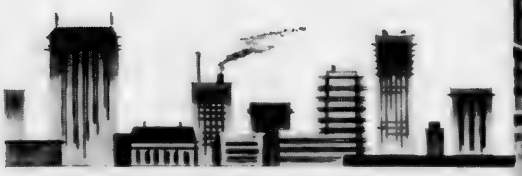

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CONTEMPORARY motif of office is enhanced by the trim, modern styling of Modine AIRditioner. Quiet, individually-controlled air conditioning provides instant comfort . . . increases employee efficiency.

COLONIAL atmosphere with a modern touch — when Modine AIRditioners provide *fresh, clean air* . . . in every climate, in every season. They solve all air conditioning and heating problems — with performance, styling, economy.

Modine AIRditioners are the quiet way to air condition new or existing buildings

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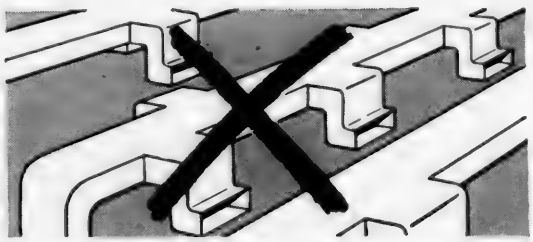

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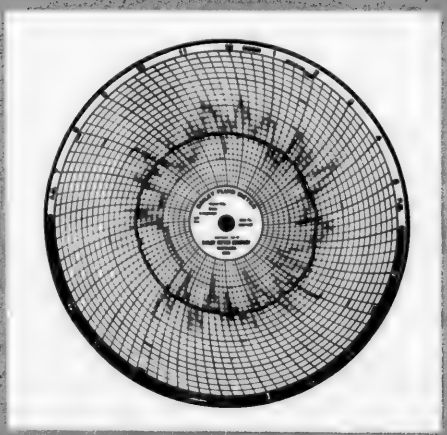

This 24-hr. pressure and flow chart shows the ability of the *Powermaster* to hold constant pressure under widely varying steam flow conditions. The basic simplicity and rugged construction of the *Powermaster* modulating burner control promptly adjusts fuel firing rate to steam demand, thus, automatically holding boiler pressure constant throughout the entire steam demand range of the boiler.

This 500 HP *Powermaster* Packaged Automatic Boiler installed in a West Coast food processing plant has led to the purchase of four *Powermaster* units by other companies in the same area.

The reason for these extra sales is because *Powermaster* is solving two steam problems—more steam for processing, and more efficient off-season heating by means of modulating control of firing rate.

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Morgantown Road, Reading, Pa.

Sound-Elec Test Chamber. Here you see Jenn-Air Exhausters on the production line, moving up for testing. Every Unit is line-lab tested for vibration, sound, motor load and insulation breakdown before leaving the plant.

THE EYE THAT SEES SOUND

This is an interior view of the Vibronic Eye Test Chamber. Through the window is shown a Quiet-tested Exhauster which has just moved into place for testing.

EXCLUSIVE JENN-AIR VIBRONIC EYE TAKES THE GUESSWORK OUT OF NOISE ELIMINATION

Simulated field conditions! Yes, that is what we do here in the Vibronic Test Chamber. An acceptable noise level is established for every Jenn-Air Fan by pre-testing. Each production unit is then required to meet these rigid standards. By finding the one noisy fan in a hundred, before it goes out, service calls and complaints from the job are held to a new low in the fan industry. Further tests are made for motor load and insulation breakdown. Jenn-Air Exhausters are designed on a new principle—U-springs suspend the power unit so vibration is absorbed. Motor and blade are balanced integrally as a further protection against vibration. *RESULT—The lowest noise level ever achieved in the roof exhauster industry.*

Jenn-Air Exhausters are rated in accordance with the Standard Test Code by the Texas Engineering Experiment Station.

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1102 Stadium Drive Indianapolis 7, Indiana

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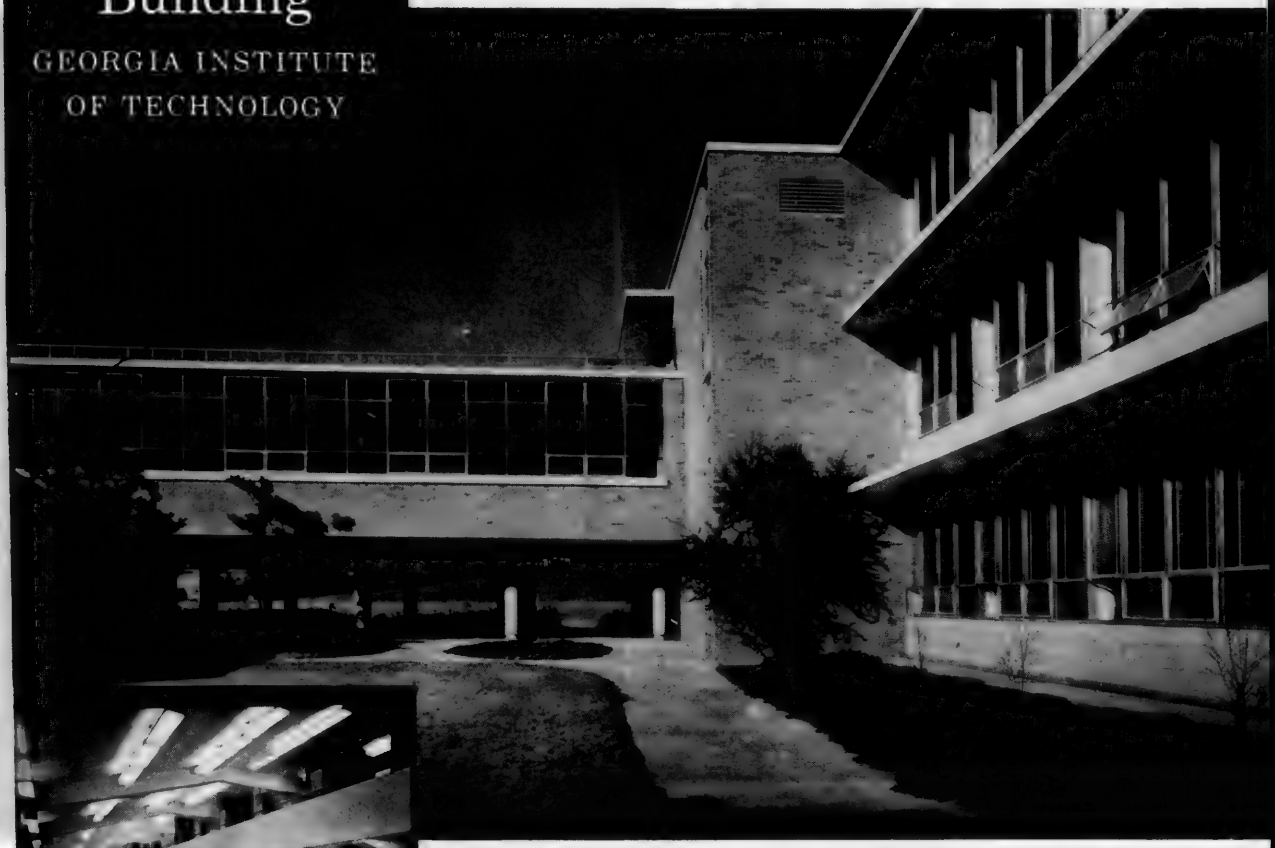
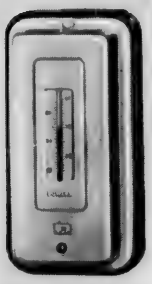
Htg. and Air Cond. Contr.: MECHANICAL CONTRACTORS & ENGINEERS, INC.





25 to 50 Years of Dependable Operation with a minimum of repairs and maintenance is often reported by users of Powers control.

(c67)

POWERS

Thermostatic Control System helps provide comfortable atmosphere for learning

"This million dollar building is unique in the annals of architectural school buildings," comments Director Bush-Brown, "in that the State of Georgia has provided for all needs in a building designed and supervised by those who will occupy it—members of the architectural staff."

The large drafting room above has a mezzanine with individual study cubicles. Auditorium and lecture room is air conditioned as is the library which preserves books and makes for year 'round comfort. Other spaces include classrooms, offices, gallery below and rooms used for judgments and exhibitions.

Consult Powers on your temperature and humidity control problems. Experience we have gained in thousands of significant buildings may be helpful to you.

THE POWERS REGULATOR COMPANY

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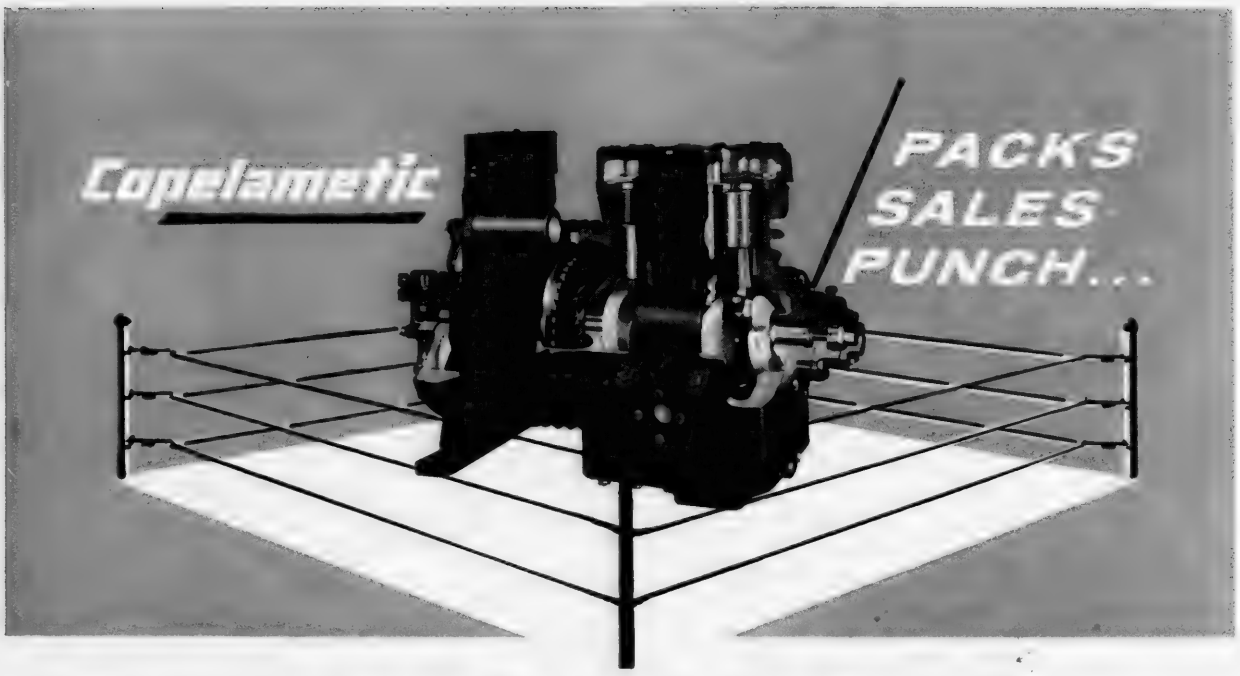
65 Years of Automatic Temperature and Humidity Control



For your packaged Air Conditioner

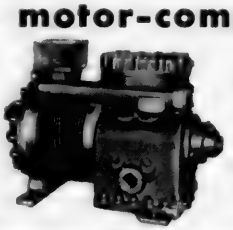
Be *positive* your air conditioner can qualify in the tough, competitive battle for public acceptance! Give your packaged unit a true, fighting heart with COPELAMETIC, the motor-compressor that sets the pace.

Every inch the champion, rugged COPELAMETIC has exceptionally high power factor to assure top performance at low operating cost. This quiet-running motor-compressor has the extra efficiency of suction cooling–a tremendous sales advantage in areas where water is not available or is too costly. Large fin surface provides faster, more efficient cooling.

Rotating parts are statically and dynamically balanced for quiet, smooth operation. Swedish steel valve reeds . . . precision-machined bronze bearings and bushings . . . hard, forged bronze rods . . . all add up to years of perfect, attention-free service. *Forced-feed lubrication* protects all moving parts. Put your packaged air conditioner in the championship class with COPELAMETIC, the accessible hermetic.

Suction-cooled *Copelametic* **motor-compressors**

FREON-12 Models
2, 3, 5, 7½ H.P.
Model shown is
8R6-200, 2 H.P.



FREON-22 Models
3, 7½ and 10 H.P.
Model shown is
the new 9R8-1000,
10 H.P.

SINCE 1918

Copeland
REFRIGERATION CORPORATION, Sidney, Ohio

moisture-proof
ALCO SOLENOID VALVES

NO COIL BURN-OUTS!

In low temperature, high humidity rooms . . . there's no danger of moisture causing failure.

Reason: The coils are impregnated with a special varnish making them moisture and corrosion resistant.

Alco Solenoid Valves are tight seating for positive shut-off. Easy to service without breaking electrical or line connections.

Alco Solenoids are manufactured by Alco to Alco's high standards.

ALCO—the most complete line for all types of refrigerant service: liquid, suction or hot gas discharge . . . brine, water, steam and air.

Write for Condensed Catalog 20 and Technical Bulletins 173 and 182

SEE YOUR ALCO WHOLESALER
. . . buy ALCO—buy QUALITY

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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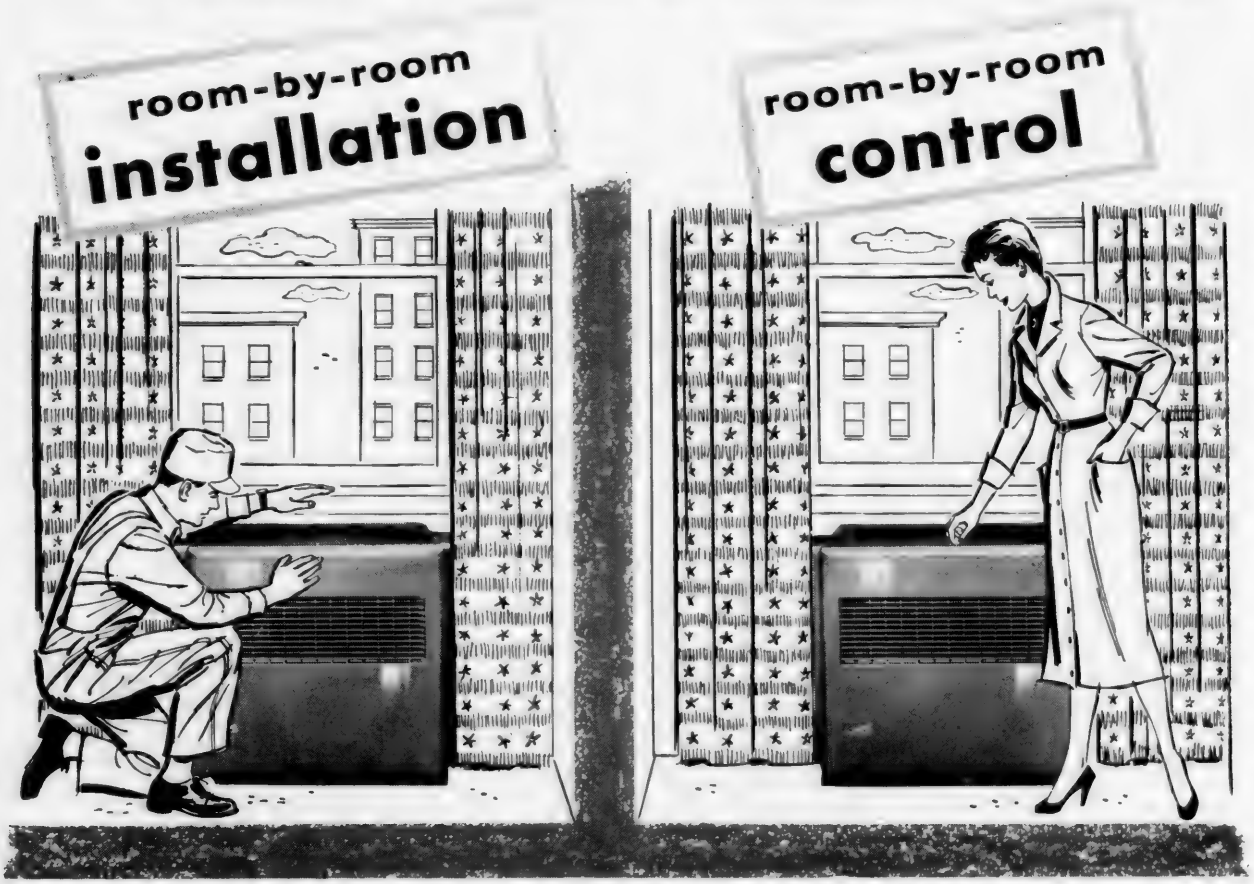
NOW —

a recessed year-round air conditioner that allows...

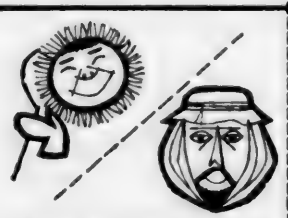


ONLY Mueller Climatrol gives you both for commercial and institutional buildings

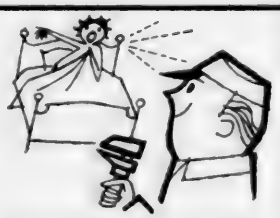
HERE'S the unit that lowers all barriers to discarding half-year comfort in favor of year-round, controlled air conditioning. New recessed air conditioners by Mueller Climatrol can be installed on a budgeted program, utilizing existing central steam or hot water facilities. For cooling, each unit is equipped with its own refrigeration cycle.

Practical cost, too — only about half as much to install as central cooling *alone!* And there's also a 20% operating saving, as compared with a complete central system.

Mueller Climatrol has literature for you with full information. Write today.

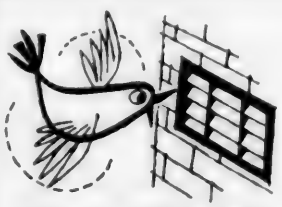


TO EACH HIS ZONE. Heating and cooling are controlled individually in each room by built-in thermostats.



TENANTS AREN'T DISTURBED. You can set up a system for installation in unoccupied rooms on a rotative basis.

NEEDS NO WATER FOR COOLING. One-hp refrigeration cycle is air-cooled — a boon in areas where water can't be used.



FLUSH WITH OUTSIDE OF BUILDING. Has a rust-proof, attractive louvre opening. Windows can be kept sealed.

Mueller Climatrol

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MILWAUKEE 15, WISCONSIN

So Halstead & Mitchell engineers said:

THIS HAS A BEARING ON COOLING TOWER PERFORMANCE'

Nothing has more bearing on cooling tower performance and life than do tower fan bearings. On them turn the induced draft cooling tower's *only moving parts.*

Announcement by Halstead & Mitchell engineers of a *permanently* sealed and lubricated fan bearing means a bearing so designed as to completely eliminate moisture —and consequent rusting of the bearing balls and races. The *elimination of periodic greasing* cuts your tower maintenance costs to an absolute minimum . . . literally adds years to cooling tower life.

With not a single bearing failure reported from the hundreds of these "new bearing" towers in actual use, Halstead & Mitchell offers you . . . now more than ever . . . the best buy in cooling towers on the market today

SUPER-QUIET, 4-BLADE FANS, TOO!

There are new fans, too, on Halstead & Mitchell Cooling Towers—deep-pitch fans which operate at much, much lower speeds—actually *cut cooling tower noise level in half.* Sturdy, stainless steel fan blades . . . stainless steel fan shafts . . . make sure your tower will have not only a quiet life, but a long one, too!

For Complete Details, Write for Bulletin CT-584

20-Year Guarantee!

...the wetted deck surface against rotting or fungus attack is an extra given you only by Halstead & Mitchell. Combined with the H & M *Protected* Steel concept, it offers unsurpassed protection against water and weather.

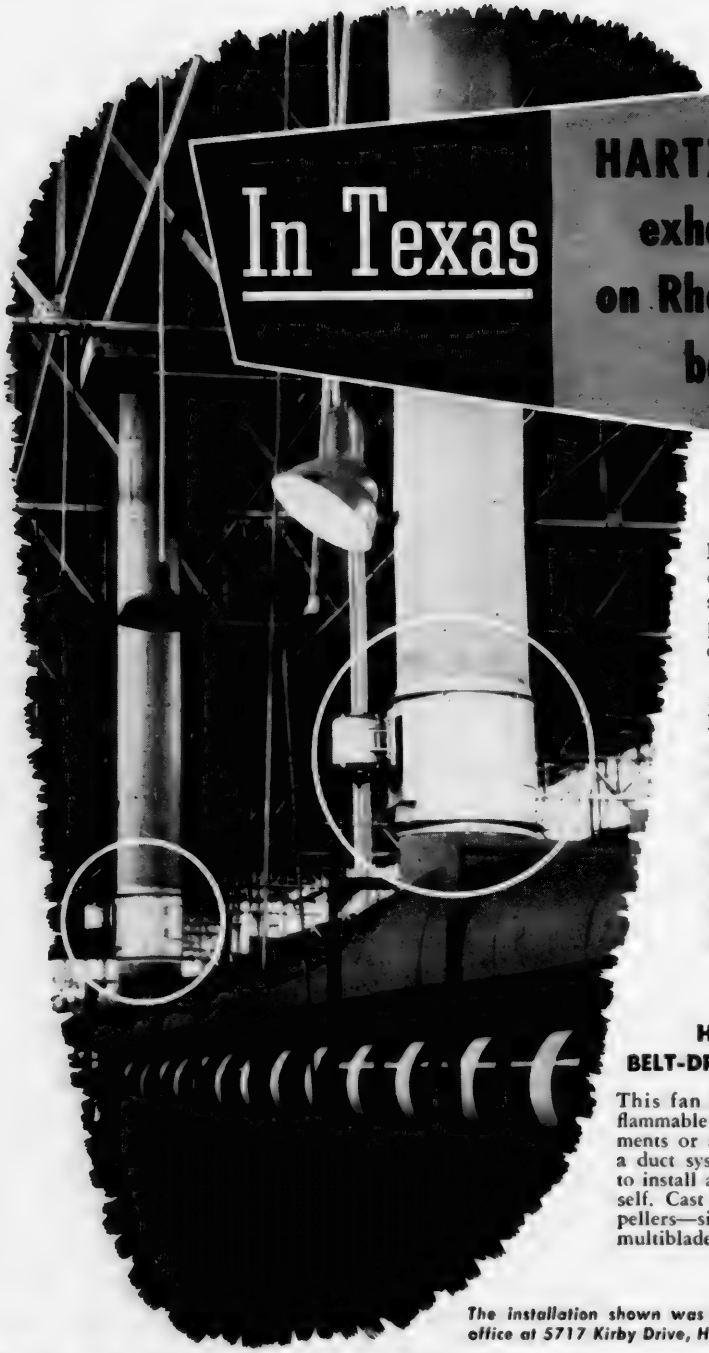
H & M COOLING TOWERS ARE AT LEADING WHOLESALERS EVERYWHERE

HM

Halstead & Mitchell

BESSEMER BUILDING, PITTSBURGH 22, PA.

New Bearing available 5 thru 50 Tons



In Texas

HARTZELL DUCT FANS exhaust smoke and fumes on Rheem's high-speed barrel production line

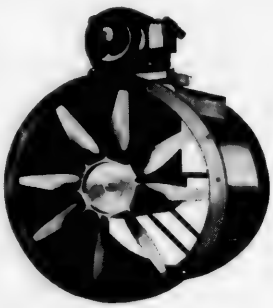
At the Rheem Manufacturing Company plant in Houston, Texas, two 24", 1 HP Hartzell belt-drive duct fans in a perforated head remove welding smoke and paint fumes along a high speed barrel production line. Other Hartzell fans power similar exhaust systems in every state in the Union.

Why should Rheem choose Hartzell? Because in thousands of tough industrial installations, Hartzell fans have proved their efficiency, rugged reliability and long life. And these are the characteristics wide-awake management demands of its air moving equipment.

If you have an air-moving problem of any kind, Hartzell fans . . . and Hartzell engineering "know-how" . . . can solve it for you. But don't wait until a problem arises . . . get acquainted now with what Hartzell can do for you. Just mail the coupon below or call your nearby Hartzell field engineer.

HARTZELL BELT-DRIVE DUCT FAN

This fan is ideal for moving flammable fumes, corrosive elements or abrasive dust through a duct system. And it's as easy to install as a section of duct itself. Cast aluminum alloy propellers—single, two-propeller or multiblade models—12" to 60".



The installation shown was handled by the Hartzell field office at 5717 Kirby Drive, Houston, Texas, phone KE-4565.

HARTZELL

propeller fan co.

Div. of Castle Hills Corp.

203 Herrman Ave. Piqua, Ohio

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

Please send me a copy of Bulletin A-109A showing Hartzell duct fans and other Hartzell air moving equipment.

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Company _____

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City & State _____

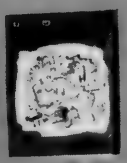
If student, check here for special information ☐

Special Tank Fabrication Problems?

If you have a special fabrication problem that involves tanks—*Novelty has a two fold solution!*

FABRICATION Novelty has over fifty years' experience engineering and building tanks of steel, stainless steel, copper, nickel, monel and all clads. Novelty offers a wide range of experience with heating elements to meet all heating problems.

LININGS Our Novelon Lining Department can offer solutions to most corrosion problems thru the use of rubber, lead, copper and the new plastic linings that allow much higher heat resistance. Considerable savings are often possible by specifying a Novelon Lining instead of more expensive steel alloys—with protection against corrosion guaranteed.



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STEAM BOILER WORKS, INC

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HOT WATER GENERATORS

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SPECIAL LININGS

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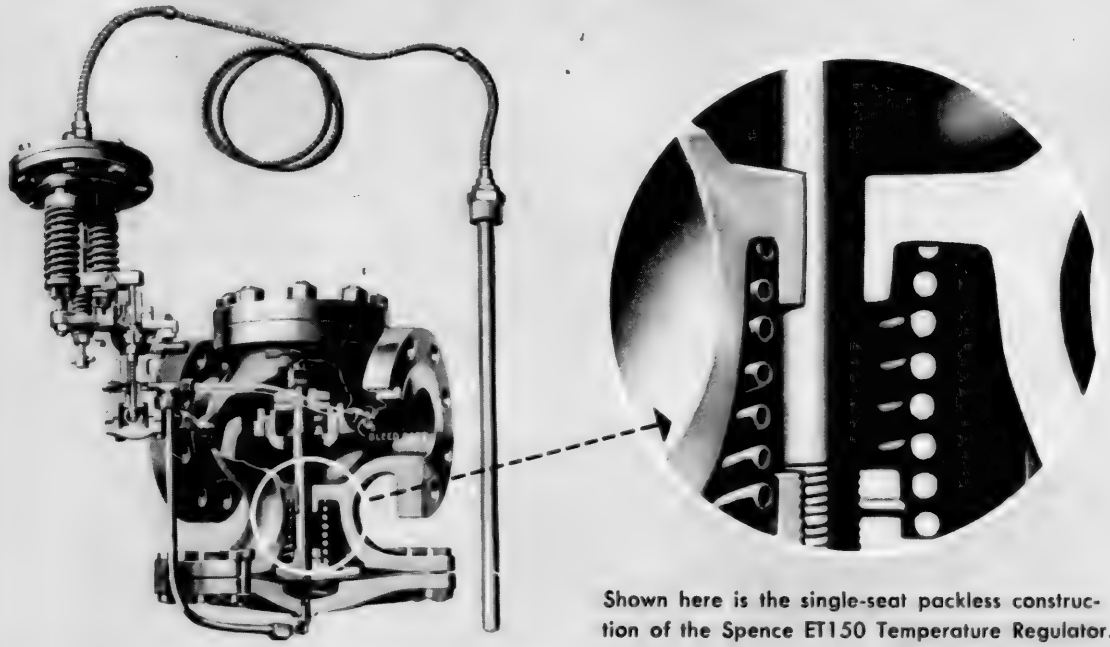
SUBSIDIARY OF ELLICOTT MACHINE CORPORATION

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, balanced metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

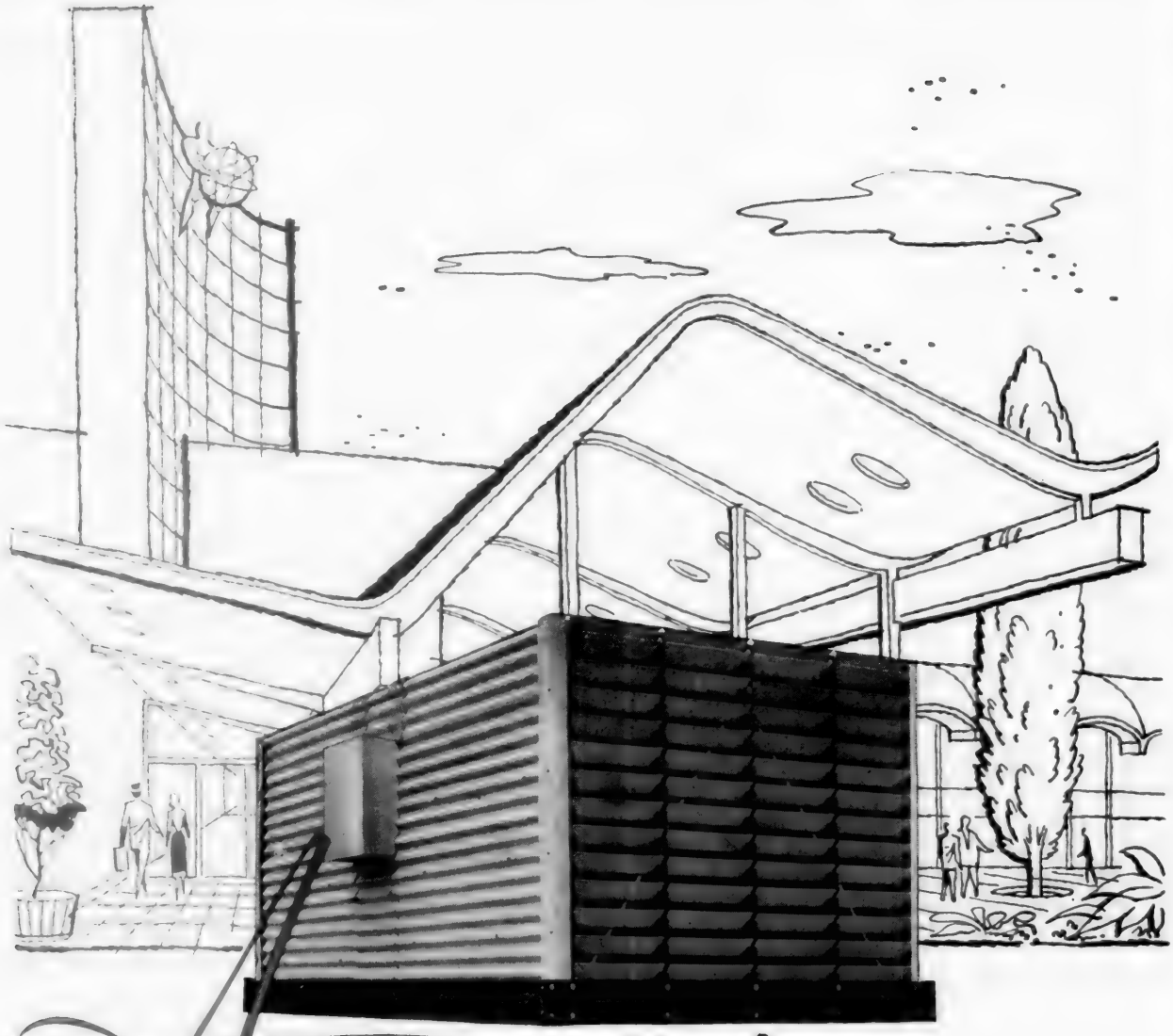
If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

ST 140



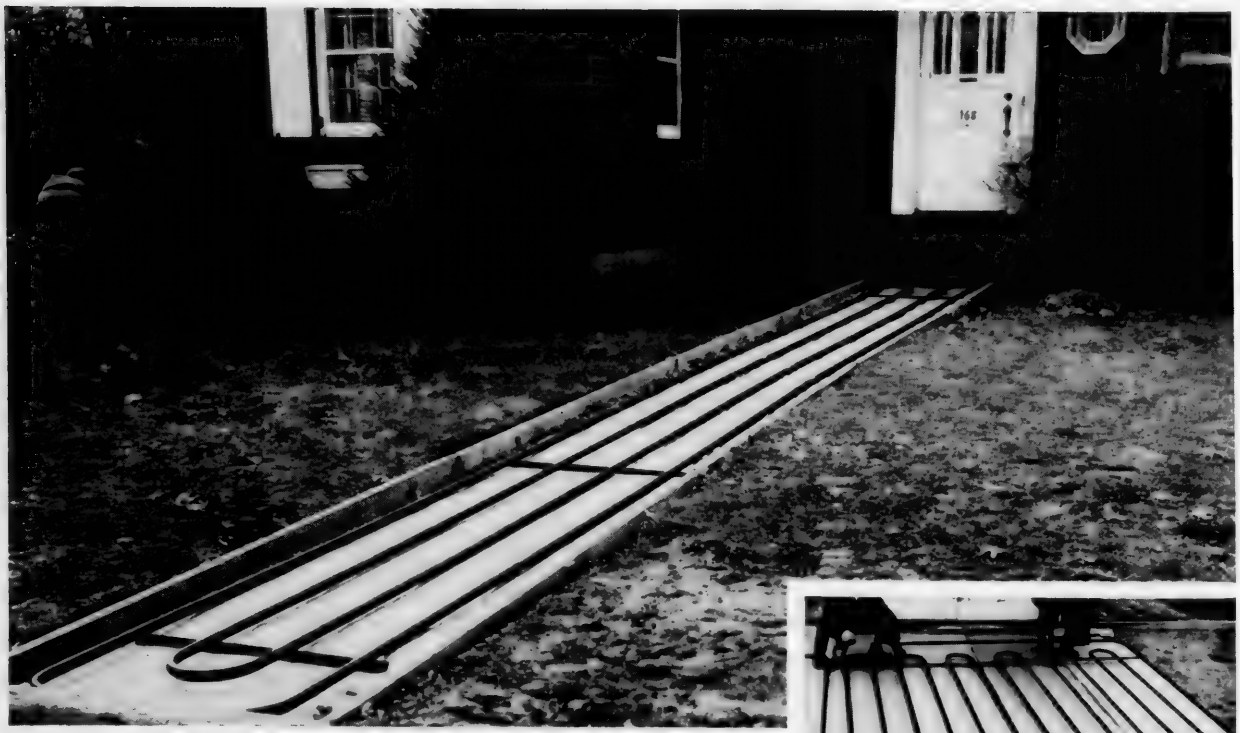
Advanced...

"Five years ahead of the field" — that is the expressed opinion of engineers and contractors who have unstintingly approved the low silhouette, high performance and rugged durability of Marley's Double-Flow Aquatower.

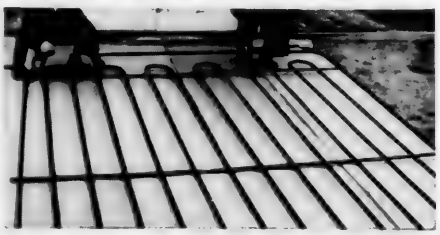
Small wonder, for this is the *original* low-silhouette tower for intermediate-capacity cooling — so original in design, so dominant in the quality of its components that it defies comparison. Even a cursory examination of its diffusion deck, fan, fill, and other functional elements stamps it clearly as the "Grade A" product in the field of institutional and commercial water cooling.

That the Double-Flow Aquatower is water cooling in a class by itself is attested by the fact that it is selected today for the great majority of all jobs that fall in its capacity range.

The Marley Company MARLEY *Kansas City, Missouri*



Fabrication and installation: Atlantic Pipe Bending and Fabricating Co., Wood Ridge, New Jersey



Snow Melting System Eliminates Winter's Worst Hazards

This modern snow melting system installed with National Pipe is the answer to winter's age-old problem—ice and snow. Dangerous slips and falls on icy sidewalks are unfortunately common winter occurrences, and many a sore back or pulled muscle has resulted from over-indulgence in snow shoveling.

Snow melting systems have been found ideal for private residences, but have been used most effectively and to far greater advantage when installed around hotels, office buildings, churches, theaters, at shipping docks, bus terminals, and highway toll gates. Versatile snow-melting coils may be installed in walkways, ramps, driveways, loading platforms, and even in stairways.

The pipe to use for snow melting applications is USS NATIONAL Steel Pipe, since it possesses the inherent qualities of smooth, uniform bending; sound, strong welding; and long service life . . . qualities that have consistently made NATIONAL Pipe the largest selling pipe in America for snow melting service.

SEE The United States Steel Hour. Televised alternate weeks. Consult your local newspaper for time and station.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
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USS

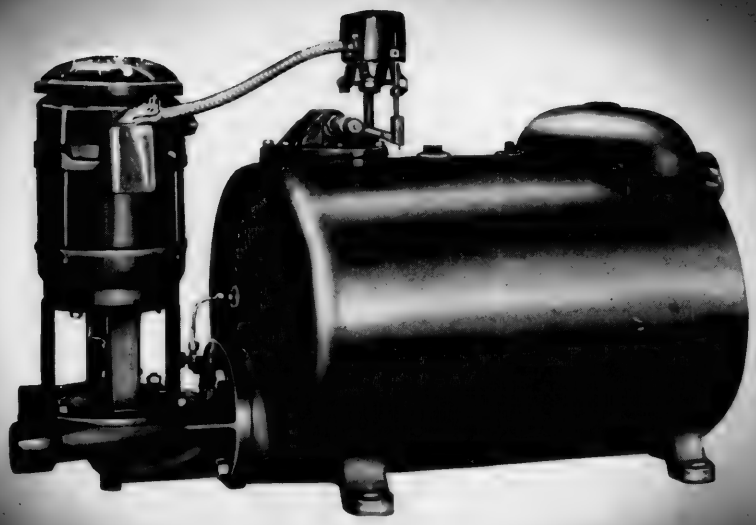
NATIONAL PIPE

UNITED STATES STEEL

SKIDMORE PUMPS

set the pace in performance *

TYPE VC PUMP



Write for Bulletin No. 10-B

TYPE UV
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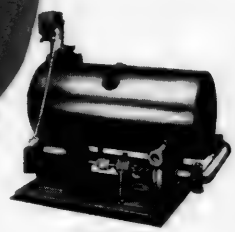

TYPE HS
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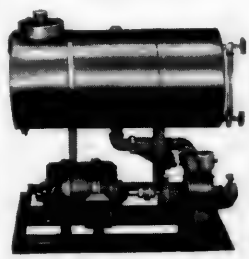

TYPE TM
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*SKIDMORE PUMPS HAVE SET A STANDARD FOR PERFORMANCE AND DEPENDABILITY SINCE 1921.

QUIET OPERATION

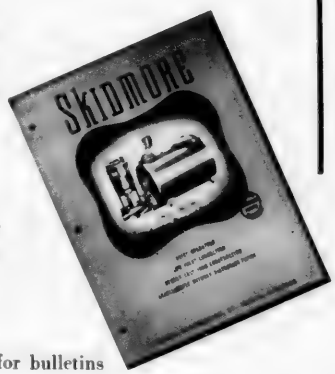
Further evidence of Skidmore's top quality engineering and knowledge of sound design is its quiet operation endowed in every Skidmore Pump.

LOW INLET CONNECTION

Suited to its specified capacities and pressures for efficient operation in every case—pump is provided with low inlet connection to render additional service and reduce installation costs for low floor returns.

ACCESSIBILITY FOR INSPECTION

Like all Skidmore Pumps the VC unit is built for dependability and freedom from troubles—is readily accessible for inspection or service without disturbing pipe connections.

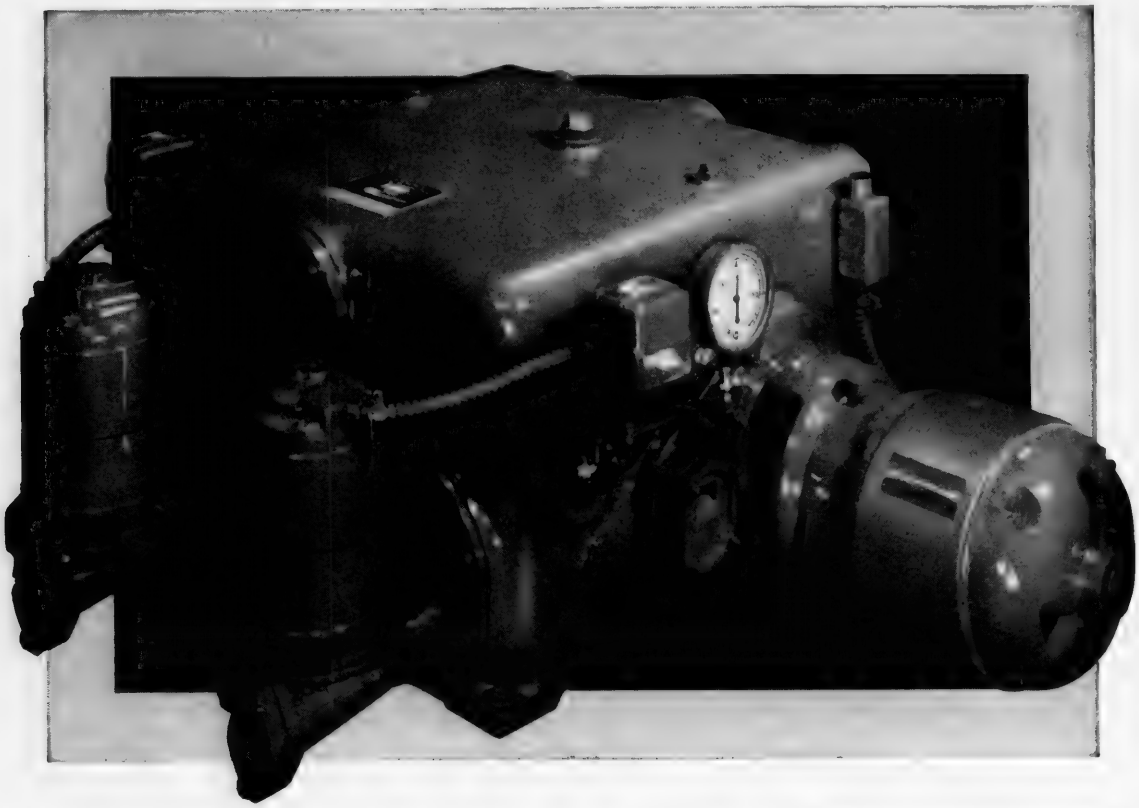


Call your nearest Skidmore Pump Representative or — write for bulletins

SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

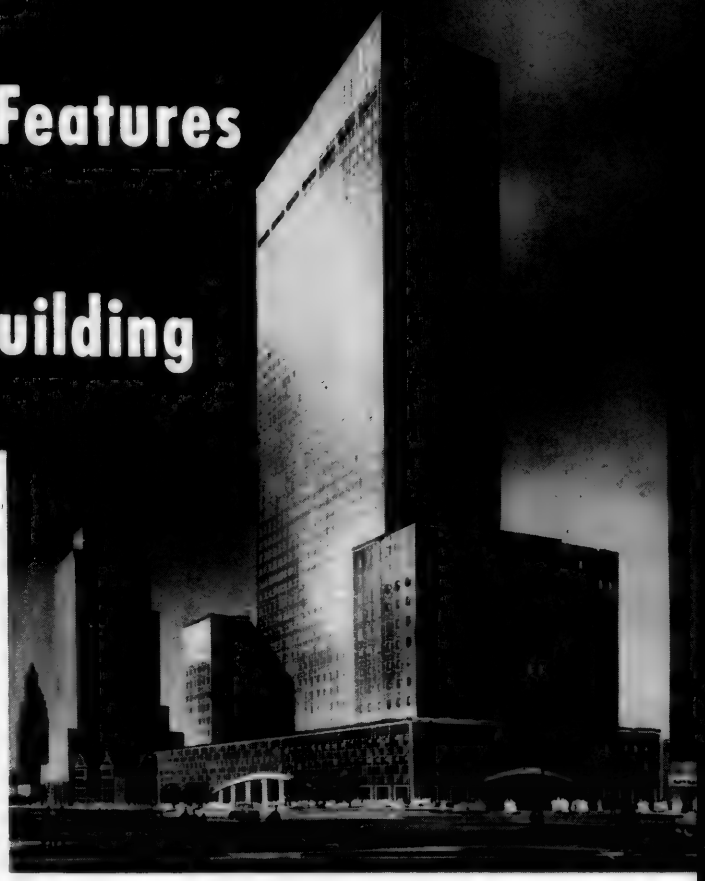
Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.

Air Conditioning Features of the Socony Mobil Building



Architects' drawing of how the Socony Mobil Building will appear when construction has been completed.

E. L. SCHULZ

Technical Advisor, Galbreath Corp., New York, N. Y.

New York City's latest major office building presented a number of new design problems to the engineer and architect who had to provide flexibility for the original whole floor or multi-floor tenants. The author describes the air conditioning systems and how some of the design problems were solved. A total of 4,000 tons of refrigeration are installed, divided between turbine-driven centrifugals in the sub-basement and absorption refrigeration units in the pent house of this multi-story building.

PROVISIONS for flexibility are important parts of the design followed for the Socony Mobil Building, the newest of the major office buildings in New York City. This building was rented to major tenants on the basis of whole-floor or multi-floor occupancy under long term leases.

Since the building was so rented, many unusual and abnormal conditions and problems in the design and construction of the building were necessarily encountered.

Architectural Flexibility for the Original Tenants

Every effort was made to provide maximum flexibility in the office ceilings and floors to permit any reasonable arrangement of tenant partitions or furniture, for the tenant in occupancy. Some of the specific decisions included:

Acoustical Ceiling. A suspended acoustical ceiling was selected incorporating a clip-on type of molding on which rested the acoustical tile, fluorescent lighting fixtures, air conditioning diffusers and transfer or return grilles. None of the foregoing items are affixed to the ceiling suspension system, but in fact are readily removable from the structure. A standard module of 12 x 48 inches is used for fluorescent lights, diffusers, grilles and acoustical tile. None of these items are affixed to the ceiling suspension system, but in fact are readily removable from the structure.

Fluorescent Lighting Fixtures. The fluorescent lights simply rest in the acoustical ceiling suspension system without the use of a standard mounting yoke. Electrical connection to the fixture is made through 6 ft (average) of Greenfield flexible conduit. Once a light is connected, it is still possible to relocate within the dimensional limits of the flexible conduit without disconnection.

Air Conditioning Diffuser. All diffusers are stamped

View of above-ceiling installation showing typical diffuser, flexible duct, sound attenuation box and fluorescent light fixture. Accoustical tile has been removed.

in a 12 x 48-inch pan to fit the standard module. These units also rest in the acoustical ceiling suspension system without a mounting yoke or other rigid connection. All supply air connections to the diffusers are provided through 8 to 10 ft of flexible round duct. As in the case of the light fixtures, the air conditioning diffusers can be relocated within the dimensional limits of the flexible duct work without disconnection.

Transfer Air Grille. In general, the return air is carried through ceiling transfer air grilles to above the hung ceiling. In this above-ceiling area, the return air enters return air screens attached to a rigid return air duct system. These transfer grilles are also set in modular 12 x 48-inch panels resting on the ceiling suspension system and can be relocated as desired.

Air Conditioning Distribution

Air conditioning for each floor is provided by two independent systems in turn served by turbine driven centrifugals and an absorption refrigeration system. There is a zoned high velocity system serving induction type units under the peripheral windows while all interior areas are served by a high velocity modified dual temperature system through sound attenuation boxes to ceiling diffusers.

Each of the peripheral system induction units is installed with an automatic water regulating valve, so that regardless of future tenant partitioning changes, automatic thermostats can be added or removed without disturbing the water circulating system. Initial installation provides for one automatic thermostat in each exterior bay to permit individual temperature control in outside private offices.

The interior zone distribution system is served by two riser shafts, located at each end of the center core of the building. Each shaft, in addition to acting as the return air shaft, contains two high velocity ducts, one for cold air and one for warm air. At every floor there is a take-off through a temperature mixing box to a single trunk duct in the ceiling of the corridor surrounding the core. As this trunk duct is continuous and is fed from mixing boxes at both ends of the core, a network feeder system is maintained. Thus any abnormal demand for air can be supplied from either mixing box or both.

From this peripheral trunk duct, there are a series of radial supply ducts feeding air to sound attenuation boxes, typically one box per bay. These boxes serve the purpose of reducing the sound level of the high velocity air to the ambient of the offices.

From each sound attenuation box, not more than four flexible ducts run to diffusers located in the acoustical ceiling. The acoustical ceiling is completely removable. In view of that fact and because the lights are on flexible conduit and the air conditioning diffusers are connected by flexible duct, it is possible to make revisions to office partitions without disconnecting and reconnecting these ceiling components.

All ducts velocities were established on the basis of economics by comparing additional excess cost of sound treatment and higher fan horsepower against reduction in material of smaller duct sizes, duct shafts and floor-to-floor height. Typical velocities for the air distribution system are: Vertical truck ducts, up to 4000 fpm; horizontal floor trunk ducts, up to 3000 fpm; radial ducts to sound boxes, up to 2500 fpm; flexible ducts to ceiling diffusers, up to 900 fpm.

Electrostatic Filters

There has been much antipathy towards the use of high efficiency electrostatic filters. There are two basic reasons for the delayed acceptance of these units. They are as follows:

1. Poor performance of the early models due to inadequate design of ionizing wires, short circuiting of cells by bugs and debris and poor design of power pack components.
2. Misunderstanding by the public of comparative performance of all filters, (throw-away, cleanable, oil bath and electrostatic) because of the three different rating or test methods sponsored by the industry.

It is the writers opinion that the first reason has been corrected by time through the availability of better materials. The second will only be corrected when the industry is willing to accept a single standard of rating based not on a percentage of dust that is arrested, but rather on the percentage of a standard dust that passes through the filter.

Electrostatic filters selected for this building are of the highest removable efficiency (or the lowest percentage of dust passed through) ever installed in a commercial building. This decision was not based on the fact that the offices might be cleaner but on two other highly important reasons.

1. Reduced maintenance on spray dehumidifiers. Because corrosive conditions in recirculating spray systems come not from the air but rather from the dirt and other contaminents in the air, a high efficiency filter can materially aid in reducing the source of corrosion.
2. Effective removal of air borne dusts will materially reduce the dirt accumulation in the air conditioning system and thus lessen maintenance costs. With the extensive use of high velocity air conditioning, there is a large quantity of acoustical material required for sound absorption. The use of higher efficiency electro-

static filters will increase the life of the acoustical material.

Air Conditioning Design Capacity

The air conditioning system for this building is designed with excess capacity because of special tenant requirements. This necessarily involved extra costs in construction. All equipment has been installed with an approximate 10% margin above a normal load of one person per 100 sq ft, 5½ watts per square foot (average) and minimum outside air of 0.3 cfm per square foot. There are two basic reasons for this decision to increase capacity:

1. With the growing trend toward mechanization of office routines, new electrical loads are continuously being added in the form of calculating machines, electric typewriters, and computers. It may not be too distant when total air conditioning loads exceed present design standards.
2. Modern office furniture include the rapidly growing modular design that permits efficient operation of large departments with employees spacing every 50 sq ft or less.

While it would be impossible to make provision for all future conditions, the uncertainty of future tenant requirements made it necessary to purchase equipment of increased capacity. Thus it was decided in this case to add approximately 10% to the capacity of the equipment originally specified.

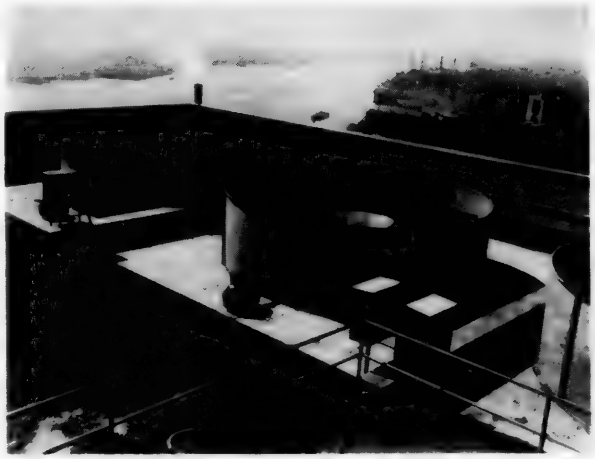
In order to initially operate the air conditioning equipment effectively, the fan motors installed have a reduced horsepower to correspond to the drive requirements of the initial building load. In addition, fans are equipped with variable inlet guide vanes. When that year arrives requiring the higher capacity of the systems, the only mechanical change required will be the simple substitution of higher horsepower fan motors.

Refrigeration Equipment

The sub-basement refrigeration plant serves all of the chilled water requirements up through the 14th floor. This includes supply to the dehumidifiers in the sub-basement and 8th floor fan rooms and secondary water distribution for the peripheral zone cooling coils through the 14th floor. The penthouse refrigeration system serves the chilled water requirements between the 15th floor and the penthouse.

The approximately 4,000 tons of refrigeration equipment is divided into 2,700 tons of turbine driven centrifugal in the sub-basement, and 1,400 tons of absorption refrigeration in the penthouse.

The high pressure steam supply to the turbines driving the basement centrifugals is reused as back pressure steam at the absorption refrigeration equipment in the penthouse. Steam condensate from the absorption machines is first used to preheat the domestic hot water system and with this heat removed, is discharged into the cooling tower sump. In addition, the unused steam from the sub-basement turbines is condensed and then pumped to the cooling tower sump. It is anticipated that steam condensate make-up to the cooling towers will normally be sufficient to obviate any make-up of city water.



Photograph taken from the top of building showing two of six cooling towers.

In purchasing the refrigeration equipment, an advantage was taken of the method of designing and manufacturing large refrigeration machinery. It is well recognized today that the wide range in capacities of a centrifugal refrigeration machine is made of an assembly of three basic components, the compressor, the condensor and the evaporator. With a relative small number of shell sizes of each component, a large number of combinations can be assembled to produce various refrigeration tonnages. It is a rare occasion when a specified tonnage exactly matches the maximum capacity available in the selected assembly of components. In the case being discussed, it was found that several hundred tons of additional capacity was available in the two 1,000-ton assemblies.

Corrosion Protection

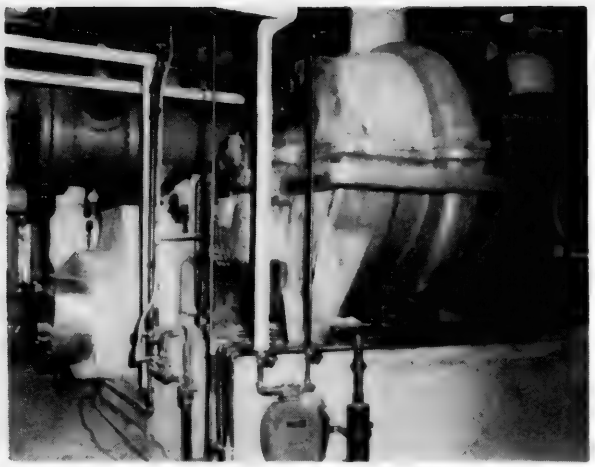
All sumps in the spray sections of the dehumidifiers are constructed of 18-8 stainless steel. The cooling tower sumps have a special non-corrosive plastic coating. The recirculating spray sections for humidification are located on the leaving side of the cooling coils to reduce corrosion of the cooling coil casings. The intermediate tube support sheets of the cooling coils are fabricated of a non-corrosive material. All of the foregoing items represent additional first costs but through savings in maintenance and operating costs, represent the lowest overall owning and operating cost.

Minimum Area for Mechanical Equipment

There are three air conditioning fan rooms in the structure. One of these, approximately 8,000 sq ft, is located in the middle of the building, the others being located in the sub-basement and the penthouse.

But there is more to this story, for the minimum number of equipment rooms represents a minimum in travel time for the operating personnel and supervision, and travel time is expensive non-productive time. In addition, concentration of equipment permits training of efficient operating crews.

No attempt was made to interconnect the chilled water or air handling system of the sub-basement and penthouse apparatus rooms. This eliminated a chilled water riser for the full height of the building. In addition, the con-



One of three turbine driven centrifugal refrigeration machines that were installed.

denser water supply and return pipe systems between the sub-basement and the cooling towers is only ⅔ size as ⅓ of the refrigeration capacity is located in the penthouse, adjacent to the cooling towers.

Use of high velocity air distribution for the interior zone considerably reduced duct sizes with a consequent reduction in shaft sizes as compared to conventional systems. No return duct is used for the shaft walls enclosing the supply air ducts act as a return system.

Because of the regulations of the New York City Zoning Laws, particularly as these laws affect vertical zoning, the building essentially consists of a 31-story tower building placed on top of a 14-story block building. Each of the lower floors has an area of 2 acres, while the upper tower floors have an area of just under one-half an acre each. Both parts of the structure represent sufficient size to warrant consideration of each as a separate building, and many of the mechanical features were designed to reflect this approach.

Air Conditioning

The sub-basement fan rooms handle all cooling and ventilating requirements for the 2nd floor and all lower floors. The 8th floor fan room serves all requirements from the 3rd to the 14th floors inclusive. The penthouse fan room serves all floors from the 15th up. There is a separate 100-ton refrigeration plant and fan room in the penthouse to handle the requirements of a private luncheon club located on the 42nd floor.

Plumbing

There are two independent plumbing systems. All plumbing stacks above the 14th floor are brought to common headers at this floor and carried in stacks to the sub-basement. In a like manner, plumbing between the sub-basement and the 14th floor is an independent system.

Efficiency of Operation

A well-designed and -operated building relies on maximum utilization of energy, both steam and electricity, and efficient utilization of operating manpower. The consulting engineers have designed for the Socony Mobil Building, mechanical and electrical systems that take long strides forward toward reaching the ultimate goal. Here are some of the design features that make this an outstanding office building.

Steam Cycle

The high pressure steam service entering the building first passes through the high pressure steam turbines driving the centrifugal refrigeration machines in the sub-basement. Utilizing a bleeder turbine, sufficient steam is extracted at 20 psig. to supply the steam requirements of the absorption refrigeration machines in the penthouse as well as the reheat coils on the 8th floor and penthouse. Any steam required by the turbines in excess of the steam demand in the penthouse is carried through the turbines to condensing. This condensate is recovered and a transfer pump delivers it to the cooling tower as make-up water.

The hot condensate from the absorption machines is first utilized in an exchanger to heat water used in the interior zone reheat coils in the penthouse. Any additional heat remaining in this condensate is then removed in an evaporative cooler and the cool condensate is delivered to the cooling tower as make-up water. Steam condensate from preheat and reheat coils in the sub-basement passes through the domestic hot water preheater, and is then delivered by transfer pump to the cooling tower pan.

The total reduction in demand for high pressure steam is estimated at 6700 lb per hr when compared with a conventional condensing turbine driven centrifugal plant.

Use of steam condensate for cooling tower make-up water not only eliminates need of city water for this purpose, but the condensate is pure and will not require treatment.

Air Cycle

On each floor of occupied area, the majority of return air passes through ceiling transfer grilles and flows above the ceiling where it removes much of the heat of the recessed fluorescent light fixtures. Because this heat is removed external to the conditioned area, an appreciable reduction in supply air quantity was possible. Thus the building enjoys the operating economy of reduced fan horsepower.

All air systems are designed to utilize up to 100% outside air during intermediate seasons, permitting a shut-down of the refrigeration systems when the outside temperatures drop below an approximate value of 45 deg F.

Construction Cost Influence on Mechanical Equipment

All too often, those most closely associated with the air conditioning and refrigeration industry fail to recognize the many other factors of installation costs that an owner faces in making a decision. Undoubtedly some will seriously question the decisions made in the design features of the Socony Mobil Building.

The refrigeration plant design using two independent central systems is a typical example. It has been asked by a single refrigeration plant was not installed in the sub-basement, or if two systems were installed, why not interconnect the chilled water lines. Here are some of the factors in making the decision:

1. If all refrigeration equipment were installed in the sub-basement, additional excessive costs of excavation of solid rock and additional foundation walls would be required. In addition, an insulated chilled water supply and return system would be required to the penthouse and condenser water lines would be increased by one-third.

2. If two centrifugal refrigeration systems were installed, one in the sub-basement and the other in the penthouse, and interconnected through the chilled water line, the heavier weight of the penthouse centrifugals and their foundations would have added substantial sums to the cost of structural steel columns. The inter-connected chilled water lines will add additional excess costs. In cases 1 and 2 there was a reduction in excess costs by eliminating steam condensers that would be required for all-turbine drive. The selected plant utilizes the absorption refrigeration machines for part of the duty of condensing steam.

In closing, it is appropriate to acknowledge the excellent work performed by the consulting mechanical engineers, Jaros, Baum & Bolles. Further acknowledgment is due to the fine work of the firm of Edward E. Ashley, consulting electrical engineers, and the architects, Harrison & Abramovitz, John B. Peterkin, Associates. The mechanical contractor responsible for carrying out the installation is Kerby Saunders, Inc., working under the general contractor, Turner Construction Company.

INTERESTING FEATURES OF AIR CONDITIONING AND REFRIGERATION INSTALLATION

Exterior Zone Dehumidified Air Systems

Total number of supply fans	4
Total cfm of supply fans	218,000
Total number of return and exhaust fans	6
Fan horsepower (supply)	425

Interior Zone Dehumidified Air Systems

Total number of supply fans	4
Total cfm of supply fans	410,000
Total horsepower of return and exhaust fans	225
Total fan horsepower (supply)	700

Ventilation Air Systems

Total number of supply fans	3
Total cfm of supply fans	61,400
Total number of exhaust fans	17
Total cfm of exhaust fans	300,000

Dehumidifiers

Total number	19
Total cfm	892,500

Miscellaneous Air Conditioning Equipment

Total number exterior induction units under windows	3275
Total number sound attenuation boxes above ceiling	1520
Total number ceiling diffusers	5400

Basement Refrigeration Plant

Refrigeration Compressors

1 with 1390 hp condensing turbine	1180 tons
1 with 680 hp condensing turbine	580 tons
1 with 1080 hp bleeder turbine	985 tons

Chilled Water System
3 pumps—7250 gpm total—310 hp total

Condensing Water Systems
3 pumps—8290 gpm total—500 hp total

Secondary Water System
4 pumps—3800 gpm total—140 hp total

Penthouse Refrigeration Plant

Refrigeration Compressors
3 absorption—1299 tons total
1 reciprocating—100 tons total

Chilled Water System
4 pumps—3685 gpm total—97.5 hp total

Condensing Water System
4 pumps—5490 gpm total—310 hp total

Secondary Water System
2 pumps—800 gpm total—30 hp total

Cooling Tower

Number of cells	6
Total gpm	13,650
Fan horsepower—6 units at 50 hp each	300
Total cfm	1,620,000

Designing High Velocity Air Conditioning Systems

G. C. Savage, engineer in charge of air conditioning for Bevington, Taggert & Fowler, Consulting Engineers Ind., explained to the Illinois Chapter, ASHAE, Indianapolis, why the high velocity type of duct distribution was selected for several installations, the problems encountered during installation, and the results obtained from those now operating.

He stated that several things had been learned about the design and installation of these systems as the number put into operation increased. Some of these findings based upon his experiences follow:

1. There is no substitute for welded ductwork.

2. Some acoustic treatment is usually necessary in the return ducts if the ducts are short and if the acoustic material can be applied close to the fan.

3. Consider the heat generated by the fans in the calculation of the heat gains.

4. Diffusers and supply outlets are selected in the same manner as for low pressure systems. However, it is desirable to use a smudge cone or ring on each one.

5. The damper or dampers must have essentially straight line characteristics and must shut off without whistling.

6. Sizing the ducts has been found to be best worked out for a maximum velocity of 4000 fpm and a maximum pressure drop of 1 in. WG per 100 ft of duct.

7. The supply fans usually turn out to be Class 2, with backward inclined blades. This type of fan has proven to be capable of delivering the required amount of air against the calculated resistance with the least power required.

8. Cooling coils are generally sized for face velocities from 400 to 450 fpm and the heating coils for velocities from 800 to 900 fpm. This is especially applicable to hot and cold deck systems and to dual duct systems.

9. Filters are selected in the conventional manner, but the best type of filters are always specified.

10. Return air fans are used wherever it is practical. By maintaining more nearly equal pressure drops across the outdoor air and return air dampers, the desired percentage of outdoor air can be more nearly achieved.

11. On dual duct systems, dampers are usually installed in the hot and cold duct connections to the plenum. These dampers are controlled by pressure regulators installed at a distance from the fan on each duct. Their purpose is to limit the pressure in one duct when most of the air flow is through the other.

Characteristics of Polyvinyl Chloride Pipe

WILLIAM P. CHAPMAN

National Tube Division, United States Steel Corporation

POLYVINYL chloride pipe—or as it is often called, PVC pipe—is a relative newcomer to the piping field. It is not a substitute material, either for metal or other plastics. It has its own place in the list of piping materials, although its potential has yet to be thoroughly evaluated.

PVC has certain characteristics that are attractive to a piping designer. In general, it is light in weight, highly resistant to most chemical attack, a good insulator (both thermal and electrical), rigid, yet has fairly good impact resistance, possesses excellent non-aging qualities and higher tensile strength than the flexible plastics. (The physical properties are listed in Table 1.)

There are two types of material listed in Table 1—normal impact and high impact. Normal impact has greater strength and chemical resistance, but lesser impact resistance. High impact is suited for installations requiring excellent chemical resistance and a high degree of toughness even at low temperatures.

These properties are best suited to handling corrosive materials at moderate pressures and temperatures. Typical applications in the air conditioning, heating and ventilating industry are brine piping, cooling water lines, and exhaust ducts for corrosive fumes.

Brine piping for process lines as well as refrigeration have long been a source of maintenance problems, mainly because of corrosion failures. Neither calcium nor sodium chlorides are detrimental to polyvinyl chloride. In fact, PVC has a better life than most stainless steels in brine solutions. This characteristic makes PVC especially suited for handling sea water.

Certain fumes are not only toxic but extremely corrosive to the usual piping materials. Take, for example, fluorine gas. Stainless steels are not recommended for this service, but, as shown in Table 2, either normal or high impact type PVC has excellent resistance to corrosion from fluorine even at 140 deg F. Other toxic, corrosive fumes are listed in Table 2 as well as some common liquids that present corrosion problems. There are many other chemicals that can be handled readily by PVC, but those listed in Table 2 are those most likely to be handled by an industrial exhaust system and are not detrimental to PVC.

TABLE 1—PHYSICAL PROPERTIES OF PVC

Physical Property		Normal Impact	High Impact
Specfic weight, lb per cu ft		86.0	84.2
Tensile strength, psi at	—40 F	12200	...
	32 F	8900	7800
	78 F	6400	6000
	140 F	4100	3600
Compressive strength, psi at 78 F		9600	8500
Impact, Izod, ft-lb per in. notch			
	—40 F	0.29	...
	32 F	0.44	...
	78 F	0.88	10.0
	140 F	4.09	...
Dielectric strength volts per mil		1413	1100
Coefficient of thermal conductivity, (Btu) (ft) (per hr) (sq ft) (deg F)		0.105	0.135
Specific heat Btu per (lb) (deg F)		0.25	0.25
Coefficient of linear expansion per deg F x 10^5		9.36	18.0

All properties based on appropriate ASTM D series tests.

There are limitations to every piping material; and for polyvinyl chloride, the chief limitations are temperature and strength.

Temperature limitations are important for two reasons. First, the tensile strength is reduced with increased temperature, and second, impact resistance is reduced with reduced temperature (see Table 1). The first effect is quantitatively demonstrated in Tables 3 and 4. Table 3 lists the maximum operating pressures at 75 deg. For example, 1 inch normal impact pipe has an operating pressure of 310 psi for standard weight, plain end. At 130 deg, we see from Table 4 that the operating pressure would be just 0.66 of that, or 205 psi. These pressures are approximately 20% of bursting pressure; that is, there is a safety factor of about 5 built into the working pressures given in Table 4.

The designer should bear in mind that there is a maximum and a minimum recommended temperature for PVC pipe. The maximum temperature has been selected with regard to the *creep* properties (a time-temperature property which occurs at stresses below the yield strength of the material). For normal impact PVC, the maximum temperature is usually taken as 150 deg; for high impact it is 130 deg.

The minimum temperature is generally set with regard

Fig. 1. PVC is lightweight, easy to handle. Four lengths of 2-inch high impact total about 50 lb. Standard lengths are 10 and 20 feet.

TABLE 2—CHEMICAL RESISTANCE OF PVC

Chemical	Normal Impact		High Impact	
	72 F	140 F	72 F	140 F*
Acetic Acid—20%)	E	E	E	F
Acetic Acid—80%)	E	G	G	NG
Ammonia Gas	E	E	E	E
Butadiene	E	E	F	NG
Butanol—Primary	E	E	NG	NG
Butanol—Secondary	E	F	NG	NG
Butyl Acetate	G	NG	NG	NG
Butyl Alcohol	E	NG	G	NG
Calcium Chloride	E	E	E	E
Carbon Dioxide	E	E	E	E
Carbon Monoxide	E	E	E	E
Carbon Tetrachloride	G	NG	NG	NG
Cellosolve	G	F	F	NG
Chlorine—Dry	E	E	E	E
Chlorine—Wet	E	G	G	F
Chlorine—Water	E	E	E	E
Ethyl Alcohol	E	E	E	E
Ethylene Glycol	E	E	E	E
Fluorine—Gas—Wet	E	E	E	E
Formaldehyde	E	E	E	F
Gas—Coke Oven	E	U	G	U
Gas—Manufactured	E	U	G	U
Gasoline—Sour	E	E	E	E
Gasoline—Refined	E	. .	NG	. .
Heptane	E	E	U	U
Hexane	E	. .	NG	. .
Hydrogen Cyanide	E	E	E	E
Hydrogen Sulfide	E	E	E	E
Methyl Alcohol	E	E	E	E
Naphtha	E	E	E	NG
Phenol	E	NG	E	NG
Phosgene—Gas	E	U	U	U
Sodium Chloride	E	E	E	E
Sulfur Dioxide	E	E	E	E
Turpentine	E	E	F	NG
Water—Acid Mine Water	E	E	E	E
Water—Distilled	E	E	E	E
Water—Fresh	E	E	E	E
Water—Salt	E	E	E	E
Water—Sea	E	E	E	E

NG—Not Good
F—Fair
G—Good
E—Excellent
U—Information not available

*Although High-Impact PVC is resistant to many chemicals at 140 F, the maximum operating temperature, based on the physical properties, is 130 F.

to impact resistance. At room temperature, normal impact PVC has about half the impact resistance of gray cast iron. High impact PVC, however, has substantial impact resistance—an Izod of 10 ft lb per in. notch. In fact, high impact PVC at 0 deg has about the same notch resistance as normal impact at room temperature.

Since PVC has such excellent chemical resistance to brines, high impact PVC is ideally suited for brine piping. It is sufficiently tough to take the abuse of industrial piping, yet it is highly resistant to chemical attack. From a cost standpoint, it is about twice as expensive as steel, but this may be offset by reduced maintenance costs.

Other advantages that help to offset the added initial cost, as compared to steel, are (1) lightweight (about one-sixth the weight of steel), (2) ease of fabrication, and (3) lower hydraulic friction (see Table 5). PVC pipe may be fabricated with welded or threaded joints. It may be cut easily with a fine tooth hacksaw or rotary pipe cutter. Schedule 40 pipe is not recommended for threading, but extra strong can be threaded easily with standard hand pipe stocks. Threaded joints are made up with much less torque than required for steel pipe.

Welded joints may be made up with thermal or solvent welds. Thermal welding is done with a hot air gun (about 425 deg is welding temperature). Welding rod of the same material as the pipe is used. Only well trained personnel should attempt thermal welding.

Fig. 2. PVC can be joined with solvent cement, hot-air welding, or threaded fittings. A full range of fittings, including nipples, flanges, tees, couplings, and elbows, is available.

An easier way to weld is to use solvent welding. This technique requires very little skill and only moderate precaution. The pipe ends and fittings should be clean (wiped lightly with carbon tetrachloride) and cut ends should be smooth. Emery cloth is fine for smoothing rough edges. A solvent cement is applied—consisting of PVC itself with a suitable solvent—to both pipe and fitting, the pieces inserted as quickly as possible, turned to expel air and to furnish intimate contact, and a joint has been made that will be as strong as the pipe itself. About 10% strength is obtained in four hours, but 48 hours

TABLE 3—MAXIMUM OPERATING PRESSURE AT 75 F

Size, Inches	Type	Std. Wt., P.E.* (Schedule 40, P.E.) psi	Extra Heavy (Schedule 80)	
			Plain End, psi	Threaded, psi
½	Normal Impact	410	575	330
	High Impact	335	470	270
¾	Normal Impact	335	470	285
	High Impact	275	385	230
1	Normal Impact	310	435	255
	High Impact	255	355	205
1¼	Normal Impact	255	360	220
	High Impact	210	295	180
1½	Normal Impact	230	325	205
	High Impact	190	265	170
2	Normal Impact	195	280	190
	High Impact	160	230	155
3	Normal Impact	185	260	170
	High Impact	150	215	140
4	Normal Impact	155	225	160
	High Impact	130	185	130
6	Normal Impact	125	195	150
	High Impact	105	160	125

*Threaded joints are not recommended for Schedule 40 pipe.

TABLE 4—TEMPERATURE—PRESSURE RELATIONSHIP

Temperature F	Temperature Factor, F	
	Normal Impact	High Impact
10	1.43	1.43
30	1.29	1.29
50	1.16	1.17
60	1.09	1.11
70	1.03	1.04
80	.97	.96
90	.90	.90
100	.84	.83
110	.78	.69
115	.75	.55
120	.73	.45
125	.69	.35
130	.66	.27
140	.59	Not Recommended
150	.53	Not Recommended

For use in equation

$p_o = Fp$

where p_o = Maximum operating pressure at operating temperature, psi

F = Temperature factor

p = Maximum operating pressure at 75 F, psi (see Table 3)

should be allowed for full strength. A full complement of fittings is available—even flanges and valves—in both socket type and threaded.

When designing the hangers and supports, it is reasonably accurate to use the following equations:

(1) When fluid temperature is below 100 deg

$$L = \sqrt{(240 - T)\,t}$$

(2) When fluid temperature is above 100 deg

$$L = \sqrt{(340 - 2T)\,t}$$

Where L = Support spacing, ft.
T = Fluid temperature, F
t = Nominal wall thickness, in.

These equations allow for a fluid of 1.35 specific gravity but no concentrated loads. If insulation is to be added, support spacing should be reduced 30%. (These equations are used with permission of Tube Turns, Inc.)

TABLE 5—HEAD LOSS OF SCHEDULE 40 PVC PIPE
(Water at 60 F)

Size*, Inches	Head Loss, Feet of Water per Hundred Feet at Corresponding Rate of Flow									
GPM	1	1½	2	3	4	5	6	7	8	9
½	1.2	2.3	3.8	7.8	13.1	20.0	27.5	37.5	46.5	59.5
GPM	1	2	3	4	6	8	10	12	14	16
¾	0.3	0.8	1.8	3.3	6.9	11.6	17.6	24.3	33.0	42.3
GPM	4	6	8	10	12	14	16	18	22	26
1	0.5	2.0	3.5	5.2	7.5	10.0	13.0	16.0	23.2	32.1
GPM	6	10	14	18	22	26	30	34	38	42
1¼	0.5	1.5	2.7	4.5	6.2	8.3	10.8	13.8	17.0	20.2
GPM	10	15	20	25	30	35	40	45	50	60
1½	0.8	1.5	2.5	3.8	5.4	7.0	9.0	11.2	13.5	18.8
GPM	10	20	30	40	50	60	70	80	90	100
2	0.3	0.9	1.7	2.6	4.0	5.7	7.3	9.6	12.0	14.5
GPM	20	40	60	80	100	120	140	160	180	200
3	0.20	.35	.80	1.4	2.1	2.9	3.9	5.1	6.5	7.5
GPM	50	75	100	125	150	200	250	300	350	400
4	0.2	0.3	0.6	0.9	1.2	2.1	3.1	4.3	5.7	7.3
GPM	100	200	300	400	500	600	700	800	900	1000
6	.024	.08	.59	.98	1.5	2.1	2.7	3.4	4.3	5.0

*Sizes of PVC pipe conform to standard pipe sizes for steel pipe.

Supports should not clamp pipe tightly. Free axial movement is required because of the relatively high coefficient of expansion.

Polyvinyl chloride pipe is relatively new in the pipe industry. It is not a substitute, but a new material that has a definite place. It should be considered by the designer whenever corrosive materials are to be handled at moderate temperatures and pressures. Typical applications are brine piping, cold water lines, and exhaust vents.

Indirect Water Heaters for Home Use

The common practice in steam or hot water heated homes is to provide hot water for washing and bathing by means of an indirect water heater attached to the house heating boiler.

Results of a study on indirect water heaters was presented at the 1956 semi-annual meeting of the American Society of Heating and Air-conditioning Engineers.

The paper, Comparative Performance of Indirect Water Heaters, was prepared by L. L. Hill, development engineer, Minneapolis-Honeywell Regulator Co., and Warren S. Harris, research professor of mechanical engineering, University of Illinois. It gave their findings after experiments conducted at the University. The paper contains a report on the availability of hot water and graphs for figuring the summer and winter operating costs for external tankless type heaters and for internal and external storage type heaters.

The water requirement for an automatic washing machine places one of the heaviest demands on a hot water heater. The authors covered both storage and tankless type heaters in tests simulating washing machine demands for hot water, both as to quantity and frequency of draw-off, based on hot water requirements obtained from several washing machine manufacturers.

A summary of the effects of control setting, tank size, and the inlet water temperature on the maximum number of loads of clothes which could be washed in succession is shown in graph and chart form.

There was no limit on the number of wash cycles which could be completed when using the tankless heater as long as the low limit control setting was above about 150 deg F. However, the variation in water temperature during any draw off was appreciable.

There was a limit on the number of wash cycles which could be completed when using the storage type heater. A 30 gal tank with a low limit control of 125 deg and a cold water temperature of 80 deg provided for only 3 consecutive washes; a cold water temperature of 60 deg reduced this to 2 washes. A 66 gal tank with a low limit control of 185 deg and cold water temperature of 80 deg made as many as 7 consecutive washes possible; a cold water temperature of 60 deg reduced this to 5 washes.

Reducing Heat Gain Through the Roof

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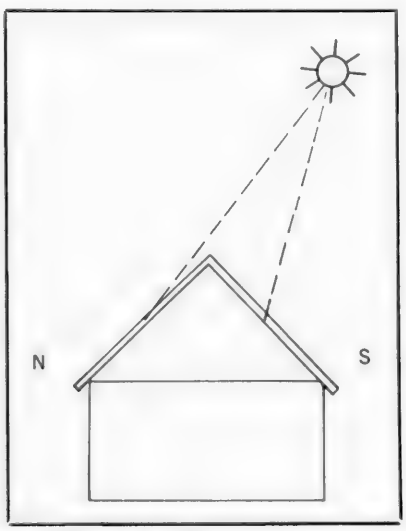
It is essential in residential air conditioning that all heat gains be held at a minimum so that both the first cost of the system and the operating costs be as low as possible. Since the roof represents as much as 35% of the total heat gain in a house, the roof requires special attention. The author describes the various methods of obtaining the minimum heat gain from solar radiation through the roof.

A SPACE-SHIP traveling outside of the earths' atmosphere would receive solar radiation from the sun on each square foot of its surface perpendicular to the sun rays, of approximately 420 Btu per hour. The solar radiation on the same space-ship after landing, say, in Lincoln, Neb., would be considerably less. The atmosphere about the earth consists of air, moisture, smoke, dust, ozone and carbon dioxide which scatter the solar radiation and absorb some of it. Quantitatively speaking, on a clear sunny July day around noon, the direct solar radiation in Lincoln would be 289 Btu per hr on each square foot perpendicular to the sun's rays plus about 35 Btu per hr on each square foot of horizontal surface from the atmosphere itself as a result of the scattered radiation which is normally termed as sky or diffuse solar radiation. If our space ship could land at LaGuardia Airport in New York City, it would receive still less direct radiation from the sun because the sun rays have to penetrate through the thick haze which usually hangs over large industrial areas. Direct solar radiation in New York amounts to only 188 Btu per hr on each square foot at right angles to the sun rays. The sky radiation, however, will increase to 69 Btu per hr per square foot of horizontal surface because of the diffusing effect of the hazy atmosphere.

The magnitude of the amount of heat due to solar and sky radiation cannot be sensed directly since, in order to convert all this radiation into heat, the receiving surface must absorb it all. Then the absorbed heat would be transmitted to the surroundings by conduction, convection and re-radiation. If such transmitting medium would exist, the maximum amount of heat that could be realized through a horizontal surface and clear atmosphere would be 324 Btu per hr per sq ft.

In order to appreciate the magnitude of this figure, one should visualize living under such a hypothetical surface. Each square foot of this surface would transmit heat that is nearly equivalent to the heat liberated by the burning of one 100-watt lamp. This is intense heat and no one could exist under such a condition. Fortunately, conditions like this cannot occur in nature. No perfect absorbent for solar radiation exists and heat cannot flow freely from one medium to the other because of the many thermal resistances in its path.

Consider a concrete flat roof on which the sun rays



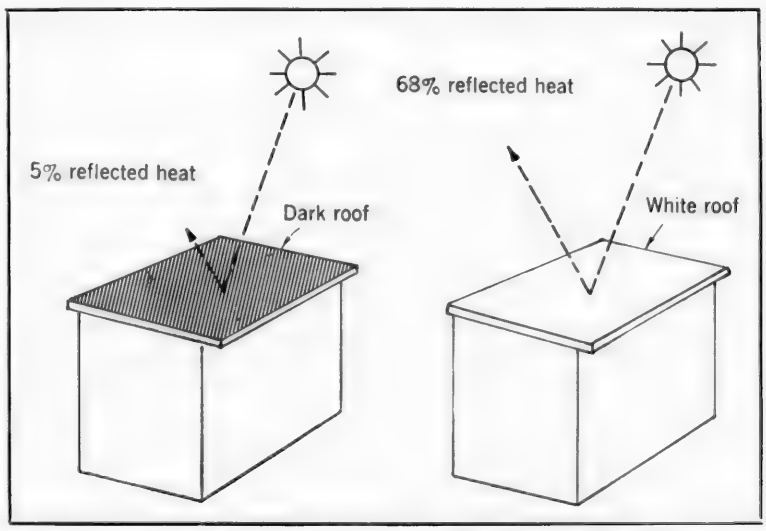


Fig. 1. (Left) If the roof ridge runs East and West, the North portion of the roof will receive little solar radiation, due to the angle of the sun's rays. Fig. 2. (Right) Comparison of roofs of dark and light color, showing difference in reflected heat.

are beating down during the noon hour. If this heat could be concentrated at one point, it would ignite wood, paper, or anything combustible. The heat absorbed travels through the roof material by conduction and enters the room below by re-radiation and convection.

Solar radiation is not the only energy source for heat generation and transmission through the roof structure. The temperature head existing between outside and indoors also causes heat to penetrate to the lower temperature levels existing indoors. The greater this temperature differential, the more heat moves through the roof. Obviously, the rate of heat transfer will be highest to air conditioned (cool) spaces. This component of the heat energy transmitted through the roof is independent of the solar radiation and is purely a function of the temperature difference between the outer and the inner side of the roof. As long as such a state of conditions exists, heat will flow instantaneously through the roof structure regardless of the composition of the roof. It is understood, of course, that the quantity of heat passing through the roof will vary according to the combined thermal resistance of the various materials of the roof. The mass of the roof has little effect on this component of the outside heat energy.

Time Lag

Solar effects are greatly retarded by the thermal capacity of the roof structure. The heat resulting from the sun rays striking the outside surface of the roof will not be evidenced indoors immediately. The thermal inertia of the mass allows only a slow movement of this heat from solar energy sources. There may be a time lag of as much as three hours in the case of a heavy mass roof before the sun's heat is sensed indoors. This is a fortunate occurrence because the peak sun effects seldom coincide with the maximum outside temperature and thus the heat gain loads do not pyramid. Solar radiation in the late afternoon hours may not be evident indoors since with falling outside temperatures, the tendency for the heat is to flow outward rather than toward the interior.

The evaluation of the combined heat gain through a roof due to solar radiation and temperature differential has been a subject of extensive study. The combined effects are now offered in terms of equivalent temperature differentials and these have been adopted by most air conditioning engineers.

The effect of heat flowing through the roof from outside to inside has been a problem of comfort. Since the advent of air conditioning, the combat against roof heat gain has been greatly intensified. Reduction of this component of the total refrigeration load is reflected not only in the lower initial investment but also in the cost of operation of the entire cooling system.

Anthony W. Carroll is supervisor of the residential and self-contained air conditioning division, application engineering department, Carrier Corp. He joined this company in 1929, after receiving his mechanical engineering degree from Cooper Union, New York City, and working for two years with a consulting engineering firm. He is co-author of Carrier's method for accurately estimating the cooling load of residences, and a member of ASHAE. The major part of his career with Carrier has been spent in application engineering, specializing in problems of heat transfer as applied through heat exchange surfaces.

To appreciate the magnitude of sunlit roof heat gain, at say 2 p.m., assume a 10,000 sq ft lightly built concrete flat roof over an air conditioned space where an 80 deg F, dry bulb temperature is to be maintained with a maximum temperature of 95 deg outside. The heat transmission coefficient through the roof is 0.34 Btu per hr (sq ft) (F) and the equivalent temperature differential is 50 deg. The heat gain through the roof will, therefore, be 10,000 x 50 x 0.34 = 170,000 Btu per hr. Going back to the previous analogy, this heat is of about the same magnitude as the heat energy liberated by the burning of 500 lamps of 100 watt each. To absorb this amount of heat by cooling, 14.2 ton of refrigeration would be required.

Assuming the initial investment at the rate of $500 per ton of refrigeration, the first cost of the cooling installation for the removal of the roof heat above would amount to $7,100. It is obvious that in the highly competitive field of air conditioning, any reasonable investment to reduce the heat gain through the roof will yield substantial savings in initial cost.

Roughly 1 brake horsepower is required for each ton of cooling. If we assume 82% motor efficiency and a 2 cent rate for each kilowatt of electrical energy, the absorbtion of the roof heat would cost 26 cents maximum for the specified hour. Of course, this figure becomes less for any other hour since the heat gain also diminishes with the movement of the sun. This cost figure may not appear significant at first, but integrated over a whole cooling season it becomes of material importance.

The reduction of roof heat gain becomes a prominent consideration when this amount of heat is viewed as a substantial fraction of the total heat gain.

In the air conditioned building used for commercial purposes, this percentage varies according to application. In a single story office building with roof of medium construction, a rough average would indicate the roof heat gain as 35% of the total. Considering a 30-ton project, the heat gain through the roof would be 10.5 tons. If this

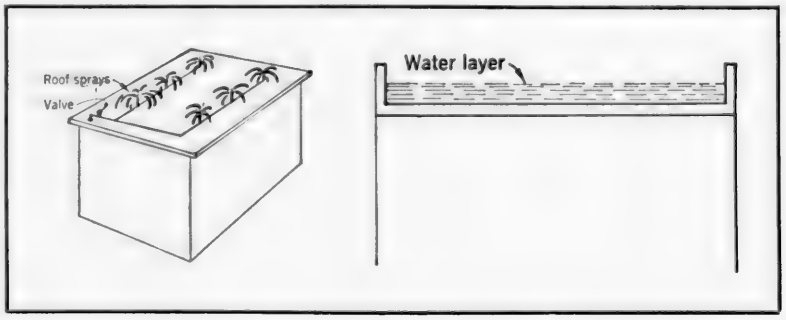


Fig. 3. (First right) Use of roof sprays to reduce heat gain through the roof.

Fig. 4. (Far right) Roof with 1 to 4 inch layer of water to reduce heat gain.

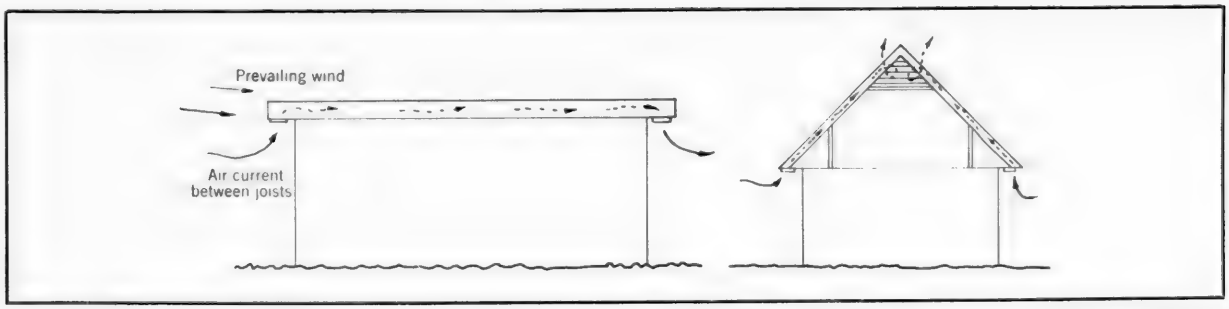


Fig. 5. (Left) Air flow under a flat roof should be parallel to the roof beams. Fig. 6. (Right) Natural convection aids in ventilating under the roof when the roof is pitched.

load could be reduced one-half by some means, the saving in first cost would be over $2600 on the $500 per ton basis.

In residences, a less protected roof will have a heat gain equivalent to 20% of the total heat gain of the house. Since in this type of building a few dollars difference can make or break a sale of air conditioning equipment, it is to the advantage of the air conditioning industry that roofs be specially constructed for air conditioning.

Construction, Orientation and Color

There are various methods of retarding the heat flow through a roof. One of the important steps is to prevent the sun rays from striking the outside surface of the roof at full intensity. This can be accomplished, in some cases, by proper orientation. A building with gable roof with the ridge running East and West will receive solar radiation in full magnitude only on one-half of the roof. The slope of one side of the roof will always make a sharp angle with the sun rays especially at higher latitude, say 40° N as in Fig. 1. For design conditions, reaching a peak at 4 p.m., the equivalent temperature differential for the North half of the roof may be taken at 8 a.m.; the other half, more or less facing the sun, should be figured for 2 p.m.

A flat roof cannot be helped by orientation. The slope required for water run-off is not sufficient to have any noticeable affect on solar radiation.

Another method of preventing the roof surface from becoming hot is to make it more heat reflective. A dark roof will reflect only 5% of the sun's heat, and the balance will be re-radiated, or lost by convection to the air. A roof painted white will reflect about 68% as shown in Fig. 2. This is true only for a smooth surface since the rate of reflection is less for a rough surface. The reflectivity of white asbestos shingles is 55%, while coarse white asphalt shingles throw back still less, only 35% of the solar radiation. Various other colors serve as better or worse reflectors; yellow is closest to white; blue is nearer black.

Contrary to common belief, unpainted aluminum shingles are poor reflectors of the short wave lengths of the sun rays. Actually they are not much better than asbestos shingles painted green.

The permanence of the light color must be established before any reduction in heat gain can be considered. In an industrial atmosphere with smoke, no credit should be given to the light color of the roof. In rural areas where the permanence of color can be depended on, the equivalent temperature difference through the roof can be reduced by about 35% in heat gain calculations.

This will also apply to white marble ships with which flat roofs or low-pitched roofs are sometimes covered. The reflectivity of the chips is about the same as white painted shingles, and the smaller the chips the higher the reflectivity.

Saving; Through Wetted Roofs

Another way to lower the roof surface temperature is to keep the surface wet. By maintaining a fine film of moisture on the surface, the heat needed for evaporation is drawn away from the roof, thereby lowering its temperature. The condenser water discharge usually provides an ample quantity of water through roof sprays for this purpose, although in some cases it may be necessary to increase the total water quantity to provide complete wetting of the roof. A good average is 100 to 150 sq ft of

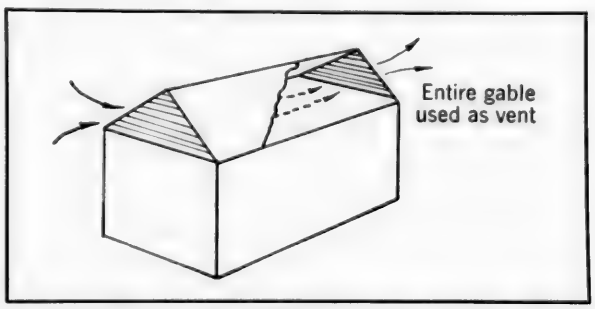


Fig. 7. For maximum ventilation under the roof, the entire gable should be louvered.

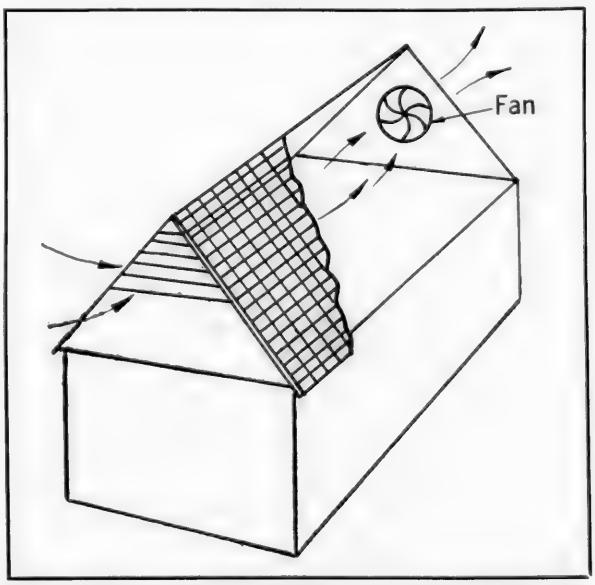


Fig. 8. Attic fans do an effective job in lowering attic temperatures. Air change should be once every 8 to 10 minutes.

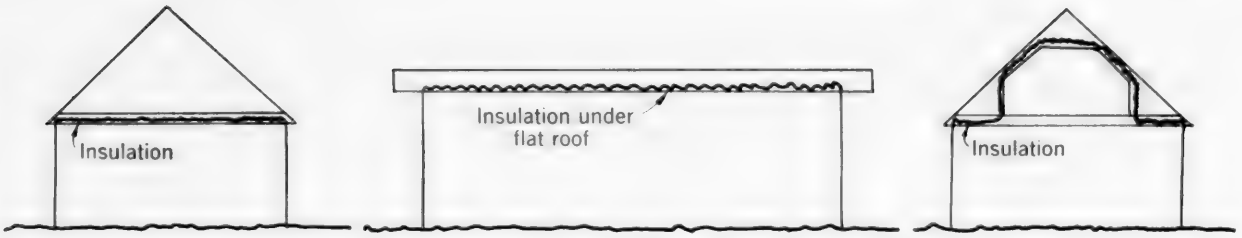


Fig. 9. Application of insulation under the roof or under the attic.

roof surface per gallon per minute of water flow. The spray is usually coarse to minimize windage loss. Water is discharged at 5 to 10 psi as higher pressures tend to produce excessive atomization. Well distributed and efficiently working roof sprays, Fig. 3, will reduce the roof heat gain about 70%. Roof sprays are best suited for flat roofs but some systems have been designed for peak roofs as well.

An alternate method of wetting the roof is applicable to flat roofs only. Here a layer of water 1 to 6 inches in depth is allowed to stand on the roof, Fig. 4. The water absorbs a large part of the radiant energy, retains it at a uniform temperature throughout the water depth and dissipates the heat back to the air through the latent heat of evaporation. The heavy layer of water permits less heat to pass to the roof because of its thermal capacity. This allows the temperature rise in the water at a slower rate. A layer one inch deep, having a lower heat capacity, warms up more rapidly and gives a higher maximum rate of heat flow earlier in the day than in the case for a 6 in. flooded roof. The reduction in heat flow through an inch layer will be 65% while the 6 in. water layer will bring the reduction to 80%, compared with dry roof coincident with maximum outside temperature.

Natural and Forced Ventilation

So far the measures recommended were for keeping down the roof surface temperature. Additional measures can be taken to remove heat from the underside of the roof, heat which has already penetrated the roof.

One of the simplest methods is a flow of air through the area below the roof. The temperature of the air in an unventilated roof space under a dark and dry roof may be as high as 150 deg. Proper ventilation of the roof space may carry away 10% to 25% of this heat.

In the case of natural ventilation, ample inlet and outlet areas and unrestricted airflow in the roof space are essential for best results. This is especially true in the case of flat roofs where the air passages are limited to the spaces between the parallel ceiling joists bounded by the roof and ceiling. Orientation of the building relative to the direction of the prevailing summer wind is of utmost importance. The building should face the wind broadside so that wind direction coincides with that of the ceiling joists as in Fig. 5. The natural ventilation of a flat roof space is wholly dependent on the outside wind movement, since there is no natural convection horizontally under a flat roof. On the other hand, ventilation of the underside of a pitched roof is produced by the natural chimney effect and it may function independently from outside wind pressure, Fig. 6. Large area soffit intakes, free "flue" passages between rafters and ample free areas in the gables for the exit of hot air are necessary to achieve efficient air wash.

The conventional small louvered vents in attics do little if any good for ventilation. These openings have insufficient free area and this is cut by as much as 50% more by the fly screen usually installed behind them. Experience tells us that, for effective ventilation, the entire gable, Fig. 7, should be used for a vent.

There are no test data available but it is safe to assume that under favorable conditions where the building is so constructed and oriented to take advantage of outside air currents, the equivalent temperature differentials through the roof may be reduced by 10%.

This reduction may be as high as 25% for forced ventilation attics. The removal of the air by fan from the roof space under a flat roof is not practical because of the inherent construction difficulties. Attic fans, as in Fig. 8, do an effective job in lowering the temperature in the attic.

The attic fan does not need to be large. One that produces a complete air change every 8 or 10 minutes is ample. The rate of 500 to 600 cfm for each 1000 square foot of attic floor is sufficient. Frequently, the fan of an air cooled condenser may be applied for this purpose when controlled by an attic air temperature thermostat. The thermostat may be set at, say, 95 deg cut-in point so that the refrigeration compressor will not be subjected to high head-pressures which would occur otherwise.

Application of Insulation

The last and most common step to prevent roof heat from entering through the ceiling, is to apply insulation, as in Fig. 9. Insulation builds up resistance to heat flow and the lower the heat transmission coefficient of the ceiling, the less heat can penetrate through. Bulk type insulation is applied in various thicknesses but seldom over 4 in. But even with 4 in., insulation the reduction in heat gain is substantial. The heat transfer coefficient of a normal ceiling with this thickness of insulation is 0.076 Btu per (hr) (sq ft) (F). This is against a coefficient of 0.60 for an uninsulated ceiling. The insulated ceiling will permit only one-eighth of the roof heat to pass through compared with the uninsulated ceiling.

Reflective insulation throws back 95% of the long heat waves re-radiated from the underside of the roof. Three-layer aluminum foil installed with four air spaces will reflect as much heat as a 6 in. bulk insulation would keep out. Two layers with 3 air spaces would be equivalent to about 4 inches of bulk insulation. This comparison is true only for downward direction of the heat flow, such as in summer.

In conclusion, the ideal roof for air conditioning would be (1) a white peak roof with the ridge running East and West, (2) where the roof space would be ventilated by a fan, and (3) the ceiling heavily insulated. The heat gain through such a roof would be only a small fraction of the total heat gain for the entire house.

AIR CONDITIONING HEATING AND VENTILATING'S

Reference Section

An Introduction to Nuclear Radiation and to Nuclear Engineering

F. W. HUTCHINSON

Professor of Mechanical Engineering, University of California, Berkeley, Calif.

Due to the ever-widening applications of atomic energy it is becoming evident that many engineers who are specialists in other fields will soon need to know at least something of the special problems associated with reactors. There will be no need for them to become specialists, but need will exist for recognition of the particular hazards and safeguards that exist wherever nuclear fission is important.

The present article is the first of a brief series designed for non-specialists and intended to provide that minimum background in nuclear physics which now seems essential to all who must concern themselves with the structure of matter. An adequate background in nuclear understanding should assist the engineer in seeing the problems of nuclear radiation in their proper perspective—of picturing the hazard of radiation damage as one element or factor among the many which establish the total environment. Recognition of the influence of temperature, humidity, noise, light, and pressure (altitude) makes it possible at least to define the problems which each of these factors imposed on the environment. Similarly, recognition of the nature and effect of nuclear radiation should assist in defining, and subsequently solving, the problem for which it is responsible. This first article of the series is a simplified review of ideas concerning the structure of matter.

An Introduction to Nuclear Radiation and to Nuclear Engineering

F. W. HUTCHINSON

Professor of Mechanical Engineering, University of California, Berkeley, Calif.

I. CHEMICAL BACKGROUND OF ATOMIC THEORY

THERE are an estimated two billion people in the world. If all of these people were placed side-by-side and each person was shrunk to the size of an average atomic nucleus, the length of the resultant human chain would be about one-tenth as long as this sheet of paper is thick. Ridiculous though this example may be it does serve to bring out two facts which are vital to a thorough understanding of the principles of nuclear engineering:

(1) The number two billion is a large one, yet when applied to the world's population it does not particularly surprise us. The reason for our acceptance is the fact that we can readily understand how the number was obtained. It would require considerable patience to count two billion people, but any of us can readily imagine that this could, approximately, be done.

(2) In contrast, the statement that two billion nuclei stretch a distance of only one-thousandth of a centimeter is much more difficult for the layman to understand. If a nucleus is that small, how can it be mea-sured? The intent of the first four sections of this discussion is to provide the engineer with an answer to such questions by providing him with an understanding of the techniques and procedures which have been employed by chemists and physicists to determine the dimensions and physical characteristics of atoms, nuclei, and nuclear particles as we now know them. Based on such an understanding it is more readily possible to work in the field of nuclear power with confidence and with overall comprehension. To attain the understanding, it is first necessary to go back in time and follow the slow but steady progress of man toward knowledge of the structure of matter.

Elements. When the elementary processes of chemistry became known to man it was soon found that many kinds of material which had been thought of as basic forms of matter were, in fact, composed of more elementary substances. In some cases, however—as with carbon or oxygen or copper—no chemical means was found for breaking up the material into parts having physical characteristics different from those of the original matter. Forms of matter having this characteristic—that is, not being susceptible to decomposition by chemical means—were defined as elements and looked upon as the fundamental "building blocks" in the field of chemistry. Around the year eighteen hundred, approximately twenty elements had been isolated and identified. At present all 92 of the elements which exist in nature have been found and, in addition, a further group of very heavy elements has been artificially created; by 1950 man had "discovered" elements which may never have previously existed.

Compounds. When two or more elements combine to form a particular material with well-defined chemical and physical characteristics that material is defined as a compound. In contrast to the relatively small number of naturally found elements—92—there are an almost limitless number of compounds known to man. In essence a compound differs from an element only in that it can be decomposed by ordinary chemical means.

Law of Conservation of Mass. As a result of Einstein's mass-energy hypothesis (to be further discussed in section 5) it is now known that in many common processes—as either ordinary combustion or nuclear fission—mass is not conserved; that is, the weight of the materials entering into the reaction is not exactly equal to the weight of the products formed. With the exception of nuclear reactions, however, this change in mass—mass defect—is so small that it cannot be measured by ordinary methods. Thus, for practical purposes (aside from nuclear reactions), it can be considered that mass is always conserved. Although this "law" is not strictly true, it was through implicit belief in its accuracy that the atomic concept first came into existence. Early chemists observed the mass relationships which hold when various elements combined and when various compounds were chemically decomposed. Their experiments led to formulation of three laws which form the foundation of modern thought concerning the structure of matter.

Law of Definite Proportions. This law was based on the observation that each particular compound always contains the same elements in the same proportion by weight. Thus, when 100 pounds of water is decomposed it always yields 88.81 pounds of oxygen and 11.19 pounds of hydrogen. Since hydrogen was the lightest known element (and still is!), it was at first decided to define the "combining weight" of each other element as that weight of the element which would combine with unit weight of hydrogen. On this basis the combining weight of oxygen (from the above data for water) would be 88.81/11.19 or 7.954.

It was soon recognized, however, that hydrogen was not a suitable standard because it forms relatively few compounds. Oxygen, which combines with a great many elements in a great many different ways, was selected as the standard and—to avoid having any combining weights less than unity—the arbitrarily selected basic weight of oxygen was taken as 8.000. On this basis the combining weight of hydrogen, W_H, was calculated from the data for water as follows:

$$88.81/8.000 = 11.19/W_H$$
$$\text{or } W_H = 1.008$$

Similarly, calcium was found to combine with oxygen in proportions of 71.47 parts of calcium to 28.53 parts, by weight, of oxygen. The combining weight, W_{Ca}, is therefore

$$W_{Ca} = (8.000/28.53)\ (71.47) = 20.04$$

Combining weights were obtained by calculation from experimental data on all of the other elements which combine with oxygen.

Law of Reciprocal Proportions. The foregoing procedure could not be applied, however, to those elements which do not react chemically with oxygen. Chlorine, for example, reacts with hydrogen to form a compound containing 97.24 parts by weight of chlorine and 2.76 parts of hydrogen. Chlorine does not, however, directly react with oxygen alone. But 1.008 parts of hydrogen react with 8 parts of oxygen so that

$$(1.008/2.76)\ 97.24 = 35.45$$

is the number of parts of chlorine that combine with the weight of hydrogen that combines with 8 parts of oxygen. In order for 35.45 to be the true combining weight of chlorine it would be necessary that "the weights of elements which react separately with identical weights of some one other element are the weights which would react with one another." Experiment established the validity of this statement and it became generalized as the law of reciprocal proportions.

Law of Multiple Proportions. As chemical investigations proceeded it soon became evident that some elements possessed more than one combining weight. When nitrogen combined with oxygen, for example, at least five different compounds were formed and the weight of nitrogen per unit weight of oxygen was different for each compound. Of great significance was the fact that for a given weight of nitrogen in each of the compounds (as 14 pounds) the weights of oxygen were found to be simple multiples of the weight found in that compound which contained least oxygen. Thus, 8, 16, 24, 32 and 40 pounds of oxygen combine with 14 pounds of nitrogen. This principle of multiple proportions was found to be applicable to many different compounds and was then generalized into a chemical law which states that "If two elements combine to form more than one compound. the different weights of one which react with a given weight of the other are always in the ratio of small whole numbers." This is the first of the many evidences of quantization—the quantizing or breaking up of things into small integral units from which larger units are built — which appeared as chemistry and physics developed.

Relationship of Combining Volumes. The six kinds of information about matter which have so far been discussed were all based on considerations of physical characteristics and of weight. A seventh piece of experimental evidence was obtained from a study of the volume relationships among gaseous elements before and after chemical combination. Whenever gases interact (at the same pressure and temperature) it was found that a simple quantized relationship exists between the volumes which combine and the volume results. One volume of hydrogen, for example, was found to combine with one volume of chlorine, or with two volumes of oxygen, or with three volumes of nitrogen; in each case the volume of the resulting gaseous compound (again measured at the same pressure and temperature) was found to equal two volumes.

Atomic Hypothesis. The simple relationship among combining weights suggested that each element is characterized primarily by its weight. If an element were broken down into smaller and smaller particles, it could be visualized that eventually a minimum discrete particle might be obtained which would, in essence, constitute the smallest possible piece of that element. But since a simple relationship exists between combining volumes (for gases) as well as for combining weights, it would be expected that if such small discrete particles, atoms, exist then there must be a simple relationship governing the number of atoms in equal volumes of gases.

The first, seemingly logical, hypothesis was that equal volumes contain equal numbers of atoms. But it has already been shown that unit volume of hydrogen combines with unit volume of chlorine to form two volumes of a resultant compound; then if each volume contains an equal number of atoms, it follows that the resultant compound must contain twice as many "atoms" of compound as there are atoms of hydrogen entering into the reaction. But such a result would mean that each "atom" of compound would contain a half atom each of hydrogen and of chlorine, a conclusion directly contrary to the idea of an atom as an "indivisible" discrete particle.

Molecular Hypothesis. The difficulty just explained was overcome by the hypothesis which conceived of each particle of a gas as being made up of molecules of one or more atoms. Then equal volumes of gases contain equal molecules and, when the gases combine, the molecules separate into atoms which then recombine to form molecules of the resultant compound. On this basis the unit volume of hydrogen would contain a certain number of molecules each consisting of two hydrogen atoms; unit volume of chlorine would have the same number of molecules each consisting of two chlorine atoms; unit volume of the resultant compound would likewise contain the same number of molecules, but each such molecule would be composed of one hydrogen atom associated with one chlorine atom. This is the present day visualization of atomic and of molecular structure.

Chemical Standard of Atomic, Molecular and Combining Weights. As previously discussed (Law of Definite Proportions), the arbitrarily selected basis for evaluation of combining weights of the elements was taken as oxygen at 8.000. In terms of atomic and molecular theory it would be convenient to assign relative atomic and molecular weights to the elements. But since all compounds are not formed by reaction of one atom of each combining element, it is evident that atomic weights would not necessarily be equal to combining weights. In water, for example, two atoms of hydrogen combine with one atom of oxygen; then if the atomic weight of oxygen were taken as its combining weight (8.000) the resultant atomic weight of hydrogen would be one half ($1.008/2 = .504$) of its combining weight.

Entirely as an arbitrary device for keeping all atomic weights greater than unity the atomic weight of oxygen was assigned a value (16.000) equal to twice its combining weight. On this basis the atomic weight of hydrogen is equal to its combining weight (1.008) and the resultant molecular weights of oxygen and of hydrogen

are then 32.000 and 2.016, respectively. Atomic and molecular weights of all other elements are then based on the arbitrarily selected oxygen values.

At the time atomic weights were established it was assumed that all atoms of any particular element have the same weight. It is now known that this is not true (refer to subsequent section 4 on Isotopes), but the statistical weight of the atom of any element *as found in nature* is a fixed value and is the value identified by the atomic weight. Thus, when the atomic weight is used it should be recognized as being chemically and statistically exact, but not applicable to some of the physical situations which occur in nuclear engineering (refer to Physical Basis of Atomic Mass, Section 4).

Valence as Defined in Terms of Atomic and Combining Weights. The atomic weight of any element is equal to or some multiple of its combining weight; the ratio is defined as *valence* and is a number which is indicative of some of the chemical properties of the element with respect to its combining characteristics with other materials. (Valance will be given additional significance later in Section 2.)

2. EXTENSION OF THE ATOMIC (QUANTIZATION) CONCEPT TO INCLUDE ELECTRICITY

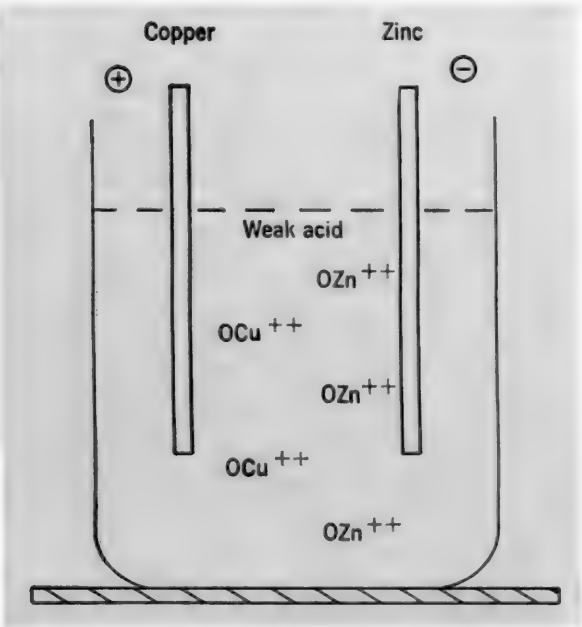


Fig. 1. Conversion of chemical energy to electrical.

The preceding section developed the experimental evidence which is back of the quantizing of matter. The present section will investigate one form of energy (in contrast to mass) and show that there is sound experimental reason for visualizing electricity as being quantized and related to small, indivisible discrete particles.

Conversion of Chemical Energy to Electrical Energy. The most simple example of a process in which matter reacts, with release of electrical energy, is that of a galvanic cell or battery. Fig. 1. shows such a cell. Two bars of any two different materials (providing that they are acted on by acid) are partially submerged in a weak acid. In the example shown, bars of copper and of zinc are submerged in any weak acid. The acid acts on both the bars, electrodes, and causes positively charged particles—ions—of copper and of zinc to go into solution. Experiment shows that the copper and the zinc ions both have associated electrical charges which are positive, so it follows (since the original system was electrically neutral) that both of the electrodes are negatively charged with respect to the solution. With any two dissimilar electrodes, however, one will be more readily acted on by the acid than will the other. In the example shown the zinc is the more susceptible; hence, a greater number of zinc ions will form than will copper ions; in consequence, the zinc electrode becomes more negatively charged than does the copper so that, with respect to the zinc electrode, the copper electrode acts as though it were positively charged. If a conductor is now connected, outside of the acid, to the electrodes an electrical current would occur from the "positive" copper electrode to the negative zinc electrode.

Conversion of Electrical Energy to Chemical Energy. A reverse of the above situation occurs when two electrodes of the same material, as copper, are connected to an external source of electrical energy (as a battery) and are then submerged in a material such as copper sulphate. The resulting process (electrolysis) is depicted schematically in Fig. 2. In this case the imposed electric current causes the positive electrode to go into solution with the formation of positively charged copper ions which migrate through the copper sulphate and are deposited, thereby being neutralized, on the negative elec-

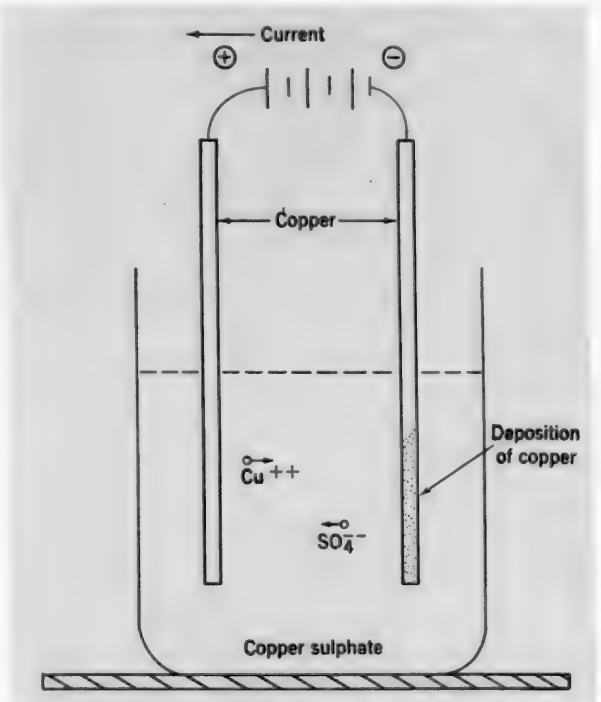


Fig. 2. Conversion of electrical energy to chemical.

trode. The effect is thus one of transferring material from one electrode to another, each charged particle or ion carrying both mass and electrical charge. This is the familiar process that is used in the common plating operation.

(a) Faraday's laws. Based on experiments in connection with electrolysis, Faraday noted two special characteristics of the process, each of which suggested some basic relationship between electricity and matter. The first observation was that the quantity of material deposited was always (for a given element) directly proportional to the quantity of electricity supplied. This suggested at once that each migrating ion carries the same quantity of electrical charge. The second observation was that for a given quantity of electricity passing through each of two systems the quantities of the two different materials deposited were in the same ratio as their combining weights.

In the case of univalent materials (as silver) it follows that the weights deposited for given quantity of electricity are in the same ratio as the atomic weights. For multivalent materials the deposition would be in the ratio of atomic weights divided by valence, A′/v′. Faraday found that for univalent materials an atomic weight of any material, in grams, was deposited by passage of 96,520.1 coulombs of electricity.

(b) The electronic hypothesis. Based on Faraday's experiments, it was hypothethized that there is some basic quantity of electricity—unit electronic charge, *e*—which is the amount needed to liberate one atom of any univalent material. Then if *F* represents the number of Faradays of electrical quantity (1F = 96520.1 coulombs) and if N_1 is the number of atoms in a gram atomic weight of any univalent material

$$1F = N_1 e \qquad (1)$$

For a multi-valent material having valence of v′ the equation becomes

$$1F = (N_1/v')e \qquad (2)$$

which provides an added use for the term "valence."

But the number of atoms in a gram atomic weight is necessarily equal to the number of molecules in a gram molecular weight (mole) and this number—to be referred to as Avogadro's Number—is the number of molecules in 22.4 liters of any gas at 0° C and standard atmospheric pressure. Then for any particular material, equation (2) relates *e* as a function of N_1, but neither of these latter constants is known. The next major advance in atomic physics was the evaluation of *e*.

Identification of the Electron in Cathode Rays. When a high potential difference is established between two electrodes in a tube that has been evacuated to about 5 mm of mercury the gas molecules within the tube become ionized and glow. If the gas is neon the color is orange-red (the familiar neon sign), whereas for other gases it will be of different hue. If, now, a small hole is cut in the positive electrode (the anode) and if the pressure within the tube is reduced to approximately 0.001 mm of mercury, the light will disappear but a region of fluorescence will be observed on a target placed back of the anode. Referring to Fig. 3 it seems evident that some kind of emission is occurring from the cathode and that such of these cathode rays as pass through the hole in the anode are responsible for the small region of fluorescence.

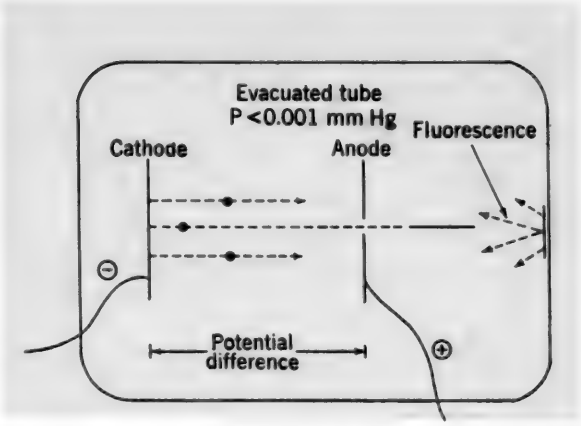


Fig. 3. Cathode rays.

Experimental investigation of cathode rays established that they have four basic characteristics:

(1) They travel in straight lines. (This was determined by using interferences to produce shadows in the region of fluorescence.)

(2) They are negatively charged particles. (Application of a magnetic pole near the fluorescent spot deflected it.)

(3) They can penetrate matter. (Interposition of this metallic foil showed lines of light streaming from the foil.)

(4) They possess kinetic energy (a small wire placed in the path of the rays become hot as a result of the cathode bombardment).

Relationship Between "Charge" as Found in Gases and in Liquids. Evidence has been given pointing to the existence under certain conditions of charged particles, ions, in liquids and in gases. A next step was to seek some relationship between these two types of charges. Experiment showed that the value of electric charge associated with 1 cc. of ionized air at 15°C and 760 mm amounted to 1.2×10^{10} esu (*esu* meaning electrostatic unit or quantity of charge; 1 coulomb = 3×10^9 esu) or

$$n' = 1.2 \times 10^{10} \text{ esu} \qquad (3)$$

where n′ is the number of molecules of gas per cc. (unknown) and *e* is the value of the charge assumed to be associated with each molecule.

But from Faraday's work it was known that 96520.1 coulombs (2.9×10^{14} esu) were associated with the unknown number of molecules in one gram mole. For an ideal gas the volume of one gram mole at 0°C and 760 mm was known to be 22.4×10^3 cm³ so that if n″ is the the number of molecules per cubic centimeter of gas at standard conditions then

$$n'' e = (2.9 \times 10^{14})/(22.4 \times 10^3) = 1.29 \times 10^{10} \text{ esu}$$

Correcting this latter term to 15°C

$$n'e = (1.29 \times 10^{10})\ (273°/288°) = 1.23 \times 10^{10} \text{ esu} \qquad (4)$$

The values of *n′e* from equations 3 and 4 agree quite well though the first is based on experiments with elec-

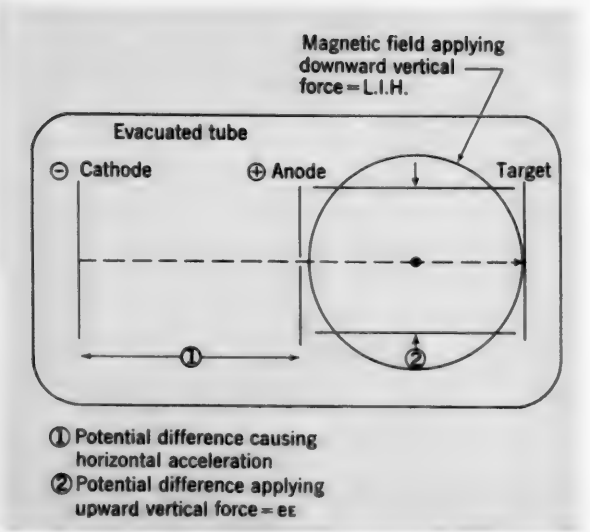


Fig. 4. Experimental determination of velocity of an electron.

tric charge in gases and the latter on Faraday's experiments with liquids. The agreement is at least sufficient to afford a clue pointing to the probability that the electronic charge, e, is the same for liquids and for gases. Note, however, that neither the number of molecules in unit volume (or in molecular weight) nor the electronic charge has yet been separately determined.

Evaluation of the Order of Magnitude of Cathode Ray (Electron) Velocity. As previously noted (refer to Fig. 3) cathode rays passing through a hole in the anode proceed in straight lines to the target. If now (refer to Fig. 4) a potential difference is established, as shown in the region between the anode and the target, the effect of this potential difference will be to exert a vertical force on the cathode particle tending to accelerate it upward; in this case the beam of cathode rays would be "bent" up and the fluorescent spot on the target would therefore be deflected upward. As an alternative consider the situation if a magnetic field were established in the same region in such a manner that it applies a force to each cathode particle which tends to accelerate it downward; in this case the beam and the fluorescent spot would both be deflected downward.

Now consider application of the electric and magnetic fields simultaneously and adjust the magnetic field to a strength such that the fluorescent spot is restored to its original undeflected position. In this case the forces exerted by the two fields must be the same or

$$eE = LIH$$

where e is the charge on the cathode particle, E the electric field strength, L the length of path of electric current I, and H the strength of the magnetic field. But an electric current is by definition an electric charge in motion so that $I = e/t$. Then LIH is equal to LeH/t, but L/t is equal to the velocity of the particle, so that LeH/t equals evH and

$$eE = evH$$

$$\text{or} \qquad v = E/H \qquad (5)$$

Both E and H are known, so that equation 5 permits determination of the cathode ray velocity *provided* all particles are travelling at the same velocity.

The fact that the above method was found to be experimentally valid established the additional fact that—for a given cathode tube—the particles do all have the same velocity. But if these particles originated in the region between the cathode and the anode, they would be acted on by the horizontally accelerating force due to the potential difference between cathode and anode for a varying length of time depending on their point of origin. In this case particles formed near the anode would pass through the hole with low velocity and would then continue at this uniform velocity until striking the target: particles formed near the cathode would be accelerated for a longer period of time and, after passing through the hole, would approach the target with a constant velocity, but one higher than for the former particle. The fact that all particles were found experimentally to have the same velocity served to show that the particles all originate at the cathode, hence, are all accelerated over the same length of path.

For ordinary experimental cathode operation the velocity was found to be of the order of magnitude of one tenth the speed of light (therefore approximately 18,600 miles per second).

Evaluation of the Ratio of Eletcronic Charge to Electronic Mass. Refer now to Fig. 5 and consider the case in which an electric field (similar to that considered in connection with Fig. 4 but of opposite direction) acts alone to deflect the particle. As the particle comes through the hole in the anode it is travelling horizontally at velocity v and it maintains this uniform horizontal velocity component until it strikes the target. When it enters the electron field, however, it is subject to downward acceleration and on leaving the field will have a vertical velocity component, v'; the value of v' will not change after the field has been left so that the remaining trajectory of the particle will consist of the downward sloping straight line, AC, of Fig 5. The magnitude of v' is given by

$$v' = at$$

where a, the downward acceleration is equal to the force due to the field divided by the mass, m, of the particle. But field force is eE so that

$$v' = (eE/M)\ t$$

The time, t, for the particle to traverse the length of field, L, is L/v where v is the known horizontal velocity component; then

$$v' = (eE/m)\ (L/v)$$

Referring to Fig 5 the ratio of lengths BC to AB is equal to the ratio of vertical to horizontal velocity components

$$BC/AB = v'/v = (eE/m)\ (L/v)/v$$

giving

$$e/m = (BC/AB)\ (v^2/EL) \qquad (6)$$

where all terms on the right side of the equation are known or determinable.

(a) Indications of the universality of the electron. The experimental value of e/m was found to be practically constant regardless of the kind of material used as a cathode or of the kind of gas used in the tube. Further,

an investigation was made of the particles emitted from certain metal surfaces when irradiated with ultraviolet light (photoelectric effect, to be discussed in a later article) and the e/m for these particles was found to have practically the same value. Similarly the negatively charged particles emitted by an incandescent filament (as in a light globe: the thermionic effect) were found to have the same e/m value as cathode particles or photoelectric particles. All of this experimental evidence suggested a basic negative particle fundamental in nature—the electron. But neither the mass, m, nor the electronic charge, e, had been separately evaluated so that, while significant, the evidence was not proof of the existence of such a particle.

(b) Explanation of the experimentally observed deviations in ratio of charge to mass. In some of the e/m experiments (particularly later experiments with positively charged particles) it was found that the experimental value of e/m was less than the expected value. This was especially true in cases where the particle velocities were unusually high. In seeking an explanation of this fact it is necessary (for the purpose of this presentation) to accept as axiomatic Einstein's equation relating mass to velocity. This equation is

$$m = m_o/(1.v^2/c^2)^{1/2} \qquad (7)$$

where m_o is the mass of an object at rest (the "rest mass"). m is the mass of the same body while travelling at velocity v; c is the velocity of light.

(1) The concept of rest mass. As shown by equation 7 the mass of any object increases very rapidly as the velocity aproaches the velocity of light. For objects that are found in the ordinary macroscopic world of engineering practice velocities are always so low—as compared with the velocity of light—that the difference between m and m_o is immeasurably small. In nuclear engineering, however, electron velocities frequently approach within a few percent of the velocity of light and the corresponding mass increase, because of this, is very great.

(2) Einsteinian relativistic mass. The observed decrease in e/m, referred to above, was attributed to a relativistic mass increase due to the high velocity of the charged particle. Velocity determinations were made and it was then found, using equation 7, that the calculated value of the rest mass restored the e/m, in each case, to its expected and constant value.

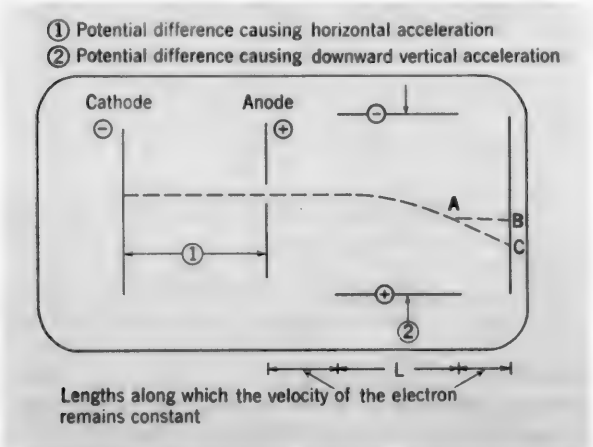


Fig. 5. Experimental determination of charge to mass ratio of an electron.

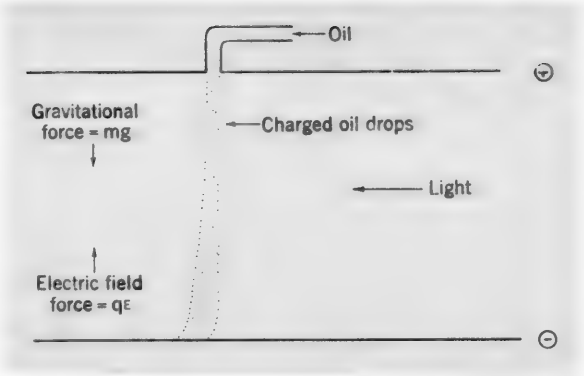


Fig. 6. Experimental determination of an electronic charge.

(3) Deviation of the usual engineering evaluation of kinetic energy. Because of the relativistic mass increase it follows that the kinetic energy associated with a moving object should be calculated using the relativistic rather than the rest mass. The amount of the deviation can be determined by writing the equation for kinetic energy in terms of relativistic mass. Thus, accepting Einstein's mass-energy equation as axiomatic

$$\text{Energy} = mc^2 \qquad (8)$$

where m is the relativistic mass and c the velocity of light: substituting for m from equation 2

$$\text{Energy} = m_oc^2/(1 - v^2/c^2)^{1/2}$$

But m_oc^2 is the energy equivalence of the rest mass so that the kinetic energy of the moving body is therefore

$$KE = m_oc^2/(1 - v^2/c^2)^{1/2} - m_oc^2$$
$$= (m_ov^2/2)\ (2c^2/v^2\ [\ (1 - v^2/c^2)^{-1/2} - 1]$$

But

$$(1 - v^2/c^2)^{-1/2} = 1 + \tfrac{1}{2}\frac{v^2}{c^2} + \frac{1.3}{2.4}\frac{v^4}{c^4} + \frac{1.3.5}{2.4.6}\frac{v^6}{c^6} + \frac{1.3.5.7}{2.4.6.8}\frac{v^8}{c^8} \cdots$$

Substituting in the kinetic energy equation and simplifying

$$KE = (m_ov^2/2)\ (1 + \frac{3}{4}\frac{v^2}{c^2} + \frac{5}{8}\frac{v^4}{c^4} + \frac{35}{64}\frac{v^6}{c^6} + \ldots\ldots) \qquad (9)$$

The first term of equation 9 is the one used in ordinary engineering calculation of the kinetic energy of moving macroscopic bodies. It is evident that this term closely approximates the true value of KE—as given by the infinite series—in all cases except those where the velocity of the object approaches the velocity of light.

Electronic Charge (Millikan Oil Drop Experiment). Fig. 6 shows in schematic form the equipment used by Millikan in attaining the isolation of an electronic charge and in evaluating that charge. Very small droplets of oil, charged as a result of friction, are subject to a downward gravitational force and to an opposing upward force due

to action of the electric field. When the two forces are exactly balanced with respect to a particular drop the drop would remain suspended and for this case

$$\text{Force} = Eq = mg$$

or

$$q = mg/E. \qquad (10)$$

With g and E known and the mass of the droplet determined experimentally, the charge q could then be evaluated. Millikan found that different droplets, regardless of the mass, frequently had the same charge and when the charge varied among drops it always varied as a fixed amount or a multiple thereof. The minimum observed charge was 4.803×10^{-10} esu and this was taken to be the quantity of electricity associated with one electron—the basic electronic charge. Subsequent experimental work verified the value of e and established the fact that it has the same value for either positive or negative charges; all static charges, whether on conductors or insulators were found to be built up of multiples of the basic electronic charge.

The Electron Volt. Since nuclear engineering is concerned with energy changes of the order of magnitude of an electronic charge, or multiple thereof, it would be convenient to have an energy unit of corresponding size. The electron volt, *ev*, is such a unit and is defined as the work done on unit electronic charge as that charge falls through a potential difference of one volt. Note particularly that an electron volt is an energy or work unit and is in no sense comparable to a "volt".

$$1 \text{ ev} = 16.0 \times 10^{-13} \text{ ergs.}$$

3. PHYSICAL CHARACTERISTICS OF ATOMS AND MOLECULES

Based on the previously established quantization of mass—in the atom—and of electrical energy—in the electronic charge, it now becomes possible to determine some physical characteristics of elementary particles.

Determination of Avogadro's Number. In an earlier section it was established that 96520.1 coulombs of electricity will deposit 1 gram mole of univalent material (as silver). In a later section it was detremined that ane electron carries a charge of 4.803×10^{-10} esu or 1.6×10^{-19} coulombs. A univalent material possesses unit electric charge so that the number of molecules present in one gram mole of silver is therefore

$$N_o = 96520.1/1.6 \times 10^{-19} = 6.025 \times 10^{23} = \text{Avogadro's Number}$$

Avogadro's number gives the number of atoms present in one gram atomic weight of any material and the number of molecules present in one gram molecular weight of any material.

Chemical Mass of an Atom or Molecule. A gram atomic weight of hydrogen weighs 1.008 grams and contains 6.025×10^{23} atoms. The rest mass of an individual hydrogen atom is therefore

$$1.008/6.025 \times 10^{23} = 1.67 \times 10^{-24} \text{gm}$$

The mass of an electron (calculable from known values of e and of e/m) is 9.108×10^{-28} gram so that the hydrogen atom weighs 1837 times as much as an electron.

By similar calculation the mass of any atom or molecule can be readily obtained.

Size of an Atom or Molecule. One gram molecular weight of water equals $2 + 16$ or 18 grams. Since the density of water is 1 gram per cubic centimeter, it follows that the molecular weight will occupy 18 cc. But a gram mole of any substance contains 6×10^{23} molecules so the volume occupied by an assumed cubical molecule of water would be

$$18/6 \times 10^{23} = 3 \times 10^{-23} \text{ cm}^3$$

Assuming the molecules spherical rather than cubical its volume would be approximately one third less than the above value (due to interstitial spaces) or

$$2 \times 10^{-23} \text{ cm}^3$$

The corresponding radius is obtained from

$$\frac{4}{3} \pi r^3 = 2 \times 10^{-23}$$

giving

$$r = 1.7 \times 10^{-8} \text{ cm}$$

The number of atoms in the usual molecule is small so that the above value, 10^{-8} cm, can be taken as indicative of the order of magnitude of atoms and molecules.

4. ISOTOPES AND THE PHYSICAL BASIS OF ATOMIC MASS

Preceding sections led to determinations of the mass and charge of an electron—the smallest (in terms of mass) known atomic "particle" and the basic electrical charge of which all other charges are now known to be multiples. The present section will extend the previous experimental work to include positively charged atomic particles and will lay the groundwork for present ideas of nuclear structure. To anticipate, work with positively charged particles showed that the nucleus of any atom consists of two types of particles, positively charged protons and electrically neutral neutrons. Protons and neutrons have practically the same mass and are the *only* two types of "building blocks" which are known to exist within the nucleus.

Experimental Investigation of Positive Rays. When a gas within a cathode tube is ionized the negatively charged particles are accelerated toward the positive anode. It would be expected, therefore, that the positively charged ions would accelerate in the direction of the negatively charged cathode. By cutting a small hole in the cathode some of the positive ions were observed passing through the opening and thereby establishing a luminous

beam. But since ionization occurs at all regions within the volume of gas it is evident that, unlike negatively charged electrons which originate at the cathode, the positive ions would not all have the same velocity. Those positive ions which formed in the gas near the anode would be accelerated throughout practically the entire distance from anode to cathode (due to the force exerted on the charged particle by the electrical field), whereas particles formed near the cathode would undergo only limited acceleration. Because of the wide range of velocities of the positively charged particles which pass through the hole in the cathode, it is evident that the experimental method used for determination of the e/m of electrons would not be applicable. Some experimental procedure is evidently needed which will fix the value of e/m independently of velocity.

(a) The fixed mass—variable velocity parabola. In the determination of cathode ray velocity the electric field and the magnetic field were caused to exert forces in opposite directions. For positive ray experiments the electric field is so established that it exerts an upward, $+y$ direction, force on the particle whereas the magnetic field exerts a horizontal, $+x$ direction, force. The electric field force is equal to the product of the particle charge, q, and the field strength, E, so that the acceleration of the positively charged particle of mass m in a vertically upward direction is

$$a = qE/m$$

By Newton's law of motion the distance travelled vertically by the particle while being acted on by the field would be

$$y = \tfrac{1}{2}\, at^2 = \tfrac{1}{2}\, \frac{qE}{m}\, t^2$$

But if the distance from the point of origin (ionization) to the cathode is L (note that this distance may differ for each particle) and if the particle velocity at time of passage through the opening in the cathode is v then the time, t, is

$$t = L/v$$

or

$$y = \tfrac{1}{2}\, \frac{qE}{m}\, \frac{L^2}{v^2} \qquad (11)$$

The force exerted on the particle by the magnetic field is directed normal to the particle path, hence is

$$qvH = mv^2/R$$

where R is the radius of the curve along which the particle is moving. From Fig. 7c

$$R^2 = (R - x)^2 + L^2$$

so that, neglecting the second order of x,

$$X = L^2/2R = HqL^2/2mv \qquad (12)$$

Then, squaring equation 12, dividing by equation 11, and solving for X^2

$$X^2 = (H^2q\ L^2/2mE)y \qquad (13)$$

All terms of equation 13 except x, y, q and m are constants of the instrument and the equation is that of a parabola giving x and y deflections of the charged particle as it leaves the electric and magnetic fields. All

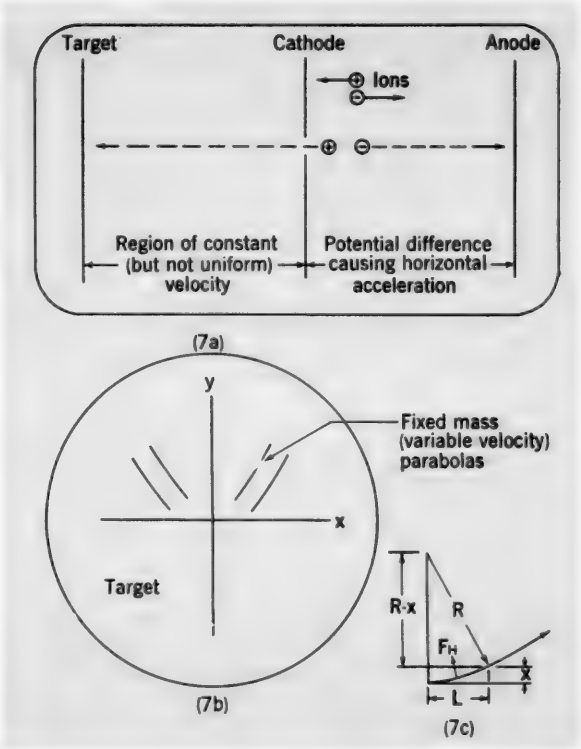


Fig. 7. Experimental determination of mass of positively charged particles.

particles having the same e/m therefore strike the target along one particular parabola (Fig. 7b), the faster particles hitting near the center and the slower ones striking farther out.

Exactness of Mass Determination. The positive ray parabola relationship proved highly effective, both as a means of investigating the charges of positive particles and as an experimental technique for accurate determination of the masses of elements. Mass determinations can now be made with an accuracy of the order of one part in one million.

Discovery of Isotopes. One of the most significant results of the positive ray experiments was discovery of the fact that all atoms of a particular element do not necessarily have the same mass. The experiments showed that each element has a particular positive charge which identifies that particular element and which is associated with particles, called protons, that equal in mass the nucleus of the hydrogen atom. Each atom (except hydrogen) also has uncharged nuclear particles, neutrons, which are practically equal in mass to protons. Thus, each nucleus consists of a group of protons and neutrons, the mass being some multiple of the mass of a proton.

On examining the mass-velocity parabola for hydrogen, it was found that three parabolas appeared on the target and the relative positions were such as to indicate that the responsible charged particles have masses in the ratio of 3 to 2 to 1. Since the charge on each particle was found to be exactly the same as that of the other particles, it followed that the three nuclei probably each consisted of one proton, the two heavier nuclei having, in addition, a neutron or two neutrons in its nucleus. Thus, the normal hydrogen atom consists of a proton

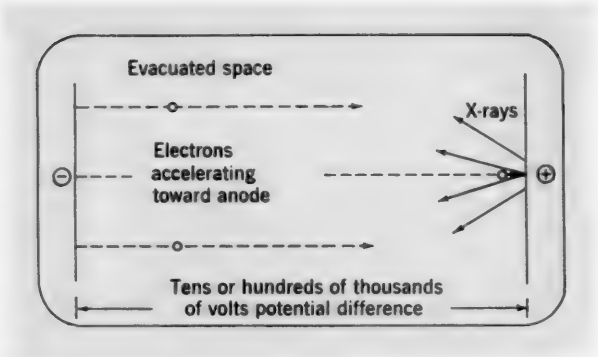


Fig. 8. X-ray production by an electron bombardment.

and an electron, the charges neutralizing one another; the mass of the proton is 1837 times that of the electron.

In any group of 10,000 hydrogen atoms 15 were found to have a mass twice as great as the ordinary atom. This heavy hydrogen "deuterium" atom has one neutron in addition to its nuclear proton. In rare instances a third hydrogen atom was found, its abundance being too low to justify assigning a number to it, but its nucleus having three times the mass of the ordinary hydrogen nucleus. This atom, called tritium, is visualized as having a nucleus with two neutrons and a proton.

The three types of hydrogen atoms were found to have exactly the same chemical characteristics; the sole difference was with respect to mass. By definition, atoms of one element which differ only in mass are called isotopes.

(a) Distribution of isotopes of the same element in nature. As yet no adequate explanation has been developed as to the origin of isotopic atoms. It has been found that the percentage distribution of isotopes of each element is evidently fixed and wherever the element may be found in nature its "natural" isotope distribution is the same. Thus, with hydrogen 99.985% of the atoms are of the lightest isotope, 0.015% are of deuterium, and a negligible number are of the very heavy hydrogen.

Physical Basis of Atomic Mass. The discovery of isotopes paved the way for a further discovery that revolutionized the entire concept of atomic weight. In 1929 it was found that atoms of the element oxygen were of three different masses. The most common type of oxygen atom (99.76%) had eight protons and eight neutrons or a mass 16 times as great as that of a hydrogen atom. Two oxygen atoms in each thousand, however, had one extra neutron and so were 17 times as heavy as hydrogen, whereas 37 atoms in each 100,000 had still another neutron, hence, were eighteen times as heavy as the hydrogen atom. It was immediately evident, then, that th arbitrary chemical selection of oxygen's atomic weight as 16.000 was no longer valid since, when based on oxygen as found in nature, the atomic weight applied not to a particular isotope but to a kind of statistically "average" oxygen atom. Physicists decided therefore to assign 16.000 to the oxygen isotope which contains that number of nuclear particles.

(a) Seemingly fortuitous relationship between arbitrary chemical selection of oxygen as standard and the actual physical significance of atomic weight. When one realizes the original selection of 16.000 as the chemical basis of oxygen's atomic weight was purely arbitrary it seems extremely fortuitous that 16.000 should also be the physical basis of oxygen mass evaluation. Actually, however, the situation is not as unlikely as it first appears to be. The original chemical selection of oxygen as 16.000 was intended entirely as a convenience in maintaining the chemical atomic weight of the lightest element—hydrogen—as slightly greater than unity. But physical investigation of atoms has shown that the reason for hydrogen being the lightest element is because it contains the minimum number of nuclear particles—a single proton. Hence, in terms of atomic structure, unity is a most acceptable mass number to assign to the lightest isotope of hydrogen and 16.000 as the corresponding mass number of the lightest isotope of oxygen.

(b) Relationship between chemical and physical mass units. For most practical purposes the difference between the physical and chemical basis of atomic weight is so small—approximately one part in four thousand—as to be negligible. In nuclear engineering, however, the distinction must be kept in mind as very small changes in mass will have large associated energy consequences.

(c) The basic atomic mass unit, *amu*. With the lightest isotope of oxygen assigned a mass number of 16.000 all other isotopes of all other atoms can be assigned mass numbers in terms of the basic atomic mass unit of 1/16 the mass of the lightest oxygen isotope. No actual isotope has a mass equal to one atomic mass unit, *amu*, but the lightest of the hydrogen isotopes comes closest with a mass of 1.0081 amu. If an isotope did exist having mass of 1 amu the rest mass of one atom of the element would be

$$1 \text{ amu}/6.025 \times 10^{23} = 1.66 \times 10^{-24} \text{ gram}$$

The rest mass of an atom of any element having mass number of A is then 1.66×10^{-24} A gram.

Information Concerning the Static Structure of the Atoms. The experimental work with positively charged particles thus provided a very large amount of data concerning the magnitude of atomic charges and the mass of various isotopes. From these data it is now possible to make a number of generalizations and to establish a rather accurate picture of the static atom.

(a) Effective mass unit equal either a proton or a neutron. The rest mass of a positively charged nuclear particle, a proton, has been determined as 1.00759 amu or 1.6724×10^{-24} gram. The rest mass of an uncharged nuclear particle, a neutron, has been determined as 1.00898 amu or 1.6747×10^{-24} gram. Thus, for all practical purposes the proton and neutron have the same mass and it is this unit of mass which varies among the isotopes of a given element.

(b) The atomic number. As previously stated it has been found that the chemical characteristics of any materials are entirely determined by its positive nuclear charge. Thus, the number of protons in the nucleus is definite identification of the element. By definition the atomic number, Z, is equal to the number of protons; hence, it is also equal to the number of electrons in the neutral atom. Hydrogen, with a single proton as its nucleus, thus has an atomic number of one whereas uranium—the heaviest of the elements found in nature—has ninety-two nuclear protons, so that its atomic number is 92.

(c) The atomic mass number. The number of nuclear protons determines the element, but the total number of nuclear particles, protons plus neturons, determines the isotope. As a simple means of differentiating between isotopes of the same element, the term atomic mass number, *A*, has come into use. The mass number is the sum of neutrons plus protons. Thus, two of the isotopes of uranium—$_{92}U^{235}$ and $_{92}U^{238}$—are seen to each have 92 protons whereas the lighter isotope has 143 neutrons and the heavier isotope has 146 neutrons.

(1) Limitations (under 1%) on validity. In a strict sense the atomic mass number indicates the number of nuclear particles. In a broader sense the mass number closely approximates the actual mass of any particular isotope. For the lightest oxygen isotope, $_8O^{16}$, the mass is by definition 16, yet for all other isotopes that have so far been discovered the actual mass is within 0.8% of the mass number. Thus, the mass number can in every case be looked on as that integer which is closest to the actual mass of the nucleus or particle in question. On this basis the electron is identified by the symbol $_{-1}e^0$ which indicates that an electron carries unit negative charge, but has a mass closer to zero *amu* than to any other value (the electron mass will be recalled to approximate 1/1837 of an atomic mass unit).

In summary, then, an atom ionizes to form one or more negative ions which are electrons and a positive ion which consists of the positively charged nucleus plus a number of electrons which are insufficient in number to balance the charge on the protons. Loss of one or more electrons from an atom alters only the charge; the chemical characteristics of the resultant positive ion are identical to those of the normal element and the isotope is in no way changed.

If an atom loses or gains a neutron its mass changes by approximately 1 amu and it becomes a different isotope of the same element. If an atom loses or gains a proton, it is automatically transmuted to a different element.

5. ELECTROMAGNETIC RADIATION

All of the manifestations of energy which have so far been discussed have involved particulate matter: Electrons of small but measurable mass carrying a negative electrical charge, protons having a mass 1837 times that of the electron but carrying a positive charge equal in value to the negative electronic charge, neutrons carrying no charge but practically equalling in mass the proton. In this section we shall investigate a basically different energy manifestation, the transfer of energy by waves without the evident presence of matter in any form.

X-Rays as Nonparticulate Energy Manifestations. When the cathode rays (electrons) from a high voltage cathode tube strike an anode which is made of one of the heavy metals, radiation is emitted from the anode (refer to Fig. 8). Since this radiation is in no way affected by either an electric field or a magnetic field, it evidently does not consist of charged particles. On the other hand the X-rays travel in straight lines, are able to penetrate matter and can be reflected, refracted and diffracted. Thus, in their general behavior X-rays resemble light and are now considered to be a form of electromagnetic radiation which differs from light only in that the wave length is much shorter. A discussion of the atomic origin and strength of X-rays will be postponed until more has been developed concerning the geometry of the dynamic atom.

Natural Radioactivity. Toward the end of the nineteenth century chemists observed that salts of uranium emitted radiation which affected a photographic plate and induced electrical conductivity (ionization) in gases. Immediate efforts were made to determine the cause and the nature of the emitted radiation.

(a) Attributable to atomic causation. It was found that neither the quantity nor the quality of radiation emitted by a given chemical compound was in any way affected by such processes as temperature change or pressure change. In the case of uranium it was further found that the amount of radiation emitted did not depend on the compound, but was directly related to the quantity of uranium in that compound. Evidently the radiation was in some way directly related to uranium atoms and must therefore be of atomic causation.

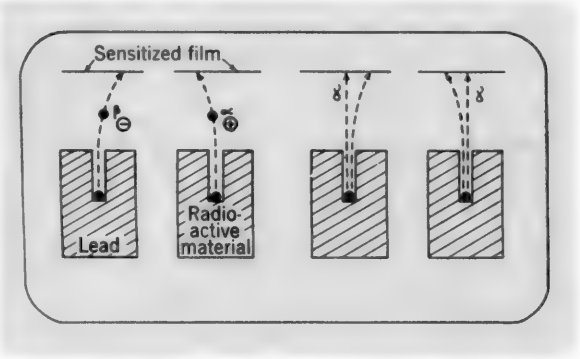


Fig. 9. Types of radioactive decay.

(b) Types of radioactive emission. By placing small pieces of radioactive material at the bottom of long grooves in a lead block the radiation emitted by the material can be caused to leave vertically. If, now, a strong magnetic field is established near the point of discharge it should be possible—assuming the radiation to be charged particles—to "bend" the emitted radiant "beam". This procedure was carried out with many types of radioactive material and a sensitized plate was used to identify the position of the emitted beam. The results, shown in Fig. 9, indicated the existence of two types of particulate radiation and of one associated type of nonparticulate radiation.

(1) Alpha particles and their characteristics. In some cases the radiant beam was deflected by the magnetic field in a direction which showed that the beam consisted of positively charged particles. This type of radioactivity was first referred to as alpha radiation and was said to consist of alpha rays. Subsequent investigation disclosed that the actual emitted alpha particle is really the doubly positive charged nucleus of the helium atom. Thus, an alpha particle is a helium ion and it consists of two protons and of two neutrons. Relatively speaking, an alpha particle is extremely heavy and though it does not possess any appreciable power of penetration (a

typical alpha particle travels at something less than one tenth the velocity of light and would be incapable of passing through this sheet of paper) it does have very great ionizing effect on any material which it penetrates.

(a) The process of alpha decay. When a radioactive element emits alpha particles it is evident that nuclear changes must be taking place. Loss of an alpha from any nucleus means a reduction in atomic number of two (hence, transmutation of that atom to a lighter element) and a reduction in atomic mass number of four. It follows, therefore, that any radioactivity which involves alpha emission must accordingly involve a spontaneous process of transmutation.

(2) Beta particles and their characteristics. With another type of radioactive decay the emitted radiation was found to be bent by the magnetic field in a direction which indicated that the radiation consisted of negatively charged particles. This type of radioactivity was originally referred to as the emission of beta rays, but subsequent investigation showed that the particles in question were electrons.

(a) The process of beta decay. All radioactive processes involve tranmutation, hence require alteration in the number of protons in an atom. In the case of beta decay the emitted electron is not one of those which make up the structure of a neutral atom, but rather is created in the process of converting a neutron into a proton. In equation form

$$_0n^1 = +1p^1 + _{-1}e^0$$

which indicates that a neutron possessing no charge but unit mass yields a proton with unit positive electronic charge and unit mass together with an electron possessing unit negative electronic charge but zero mass number.

In the process of beta decay the atom is transmitted to an element having an atomic number one higher than the parent atom, but of equal atomic mass number. Thus, beta decay creates a heavier element (but an isotope of equal mass) whereas alpha decay creates a lighter element as well as a lighter (by four amu) isotope.

Beta particles are more penetrating—but produce less ionization—than alpha particles, but even so they are readily stopped by a thin (2mm) sheet of aluminum foil.

(3) Gamma waves and their characteristics. Some radioactive materials, whether decaying by alpha emission or by beta emission, were found also to radiate nonparticulate energy in the form of electromagnetic waves similar to X-rays or to light. This type of emission, called gamma rays, was found to be characterized by low ionizing power, but by very great capacity for penetration.

(a) The Einsteinian explanation of gamma emission. In an earlier section Einstein's equation for the conversion of mass to energy was given. As will be seen later the processes involved with change in the structure of a nucleus frequently lead to the conversion either of mass to energy or of energy to mass. When transmutation of an atom takes place as a result of either alpha or beta decay, there may be (but not always is) a small reduction in the mass of the remaining nucleus, hence, liberation of a quantity of energy which then leaves, without any associated mass, as a gamma ray. From another standpoint a gamma is emitted in the process which permits an unduly energized or "excited" nucleus to return to its "ground" state or normal energy level.

6. GEOMETRY OF THE ATOM

Preceding sections have established the three fundamental atomic "building blocks" as the proton, the neutron, and the electron. Further, it has been established that certain elements, as radium and uranium, are given to spontaneous transmutation to other more stable elements and that, as a consequence of the transmutations, radioactive emissions of both nuclear particles, and electrons, and electromagnetic radiations may occur. The intent of the present section is to investigate the structural arrangement within the atom and thereby to pave the way for a more detailed analysis of the types of atomic and nuclear processes which are important to man.

Concept (and Consequences) of a Solid Atom. One of the first attempts to explain or to describe the internal construction of the atom was based on it visualization as a solid sphere, of known diameter approximating 10^{-8} centimeters, consisting of crowded neutrons, protons and electrons, the number of each such "building" block being scattered rather uniformly through the "solid" atom (refer to Fig. 10a). In terms of this picture there would be only minor electrical forces within the atom as the number of electrons equalled the number of protons, and since their respective charges are equal and opposite in size they would be expected largely to cancel one another.

When such an atom was bombarded with a charged particle, such as an alpha particle, it would be expected that the alpha would penetrate the atom, but would not be appreciably affected by electrical forces of repulsion. As the alpha entered a region near a proton there would be some repulsion and as it approached an electron there would be attraction, the expected overall effect being many minor deflections of the alpha particle, but each such deflection being of the order of only a few degrees.

Experimentally, however, the above expectations were not at all realized. Alpha particles were found to penetrate far within the atom without undergoing any appreciable deflection, but as they closely approached the center terrific force of repulsion was evidenced and the alpha particle was frequently deflected through a very large angle. Thus, alpha deflections proved that the concept of a solid atom was not valid.

Concept of a "Nuclear" Atom. One immediate means of explaining the large alpha deflections would be to picture the mass of the atom, and all of its positive charge, located in a very small dense nucleus and surrounded at relatively great distances by the electrons (refer to Fig. 10b). Thus, a dense central core (the nuclear material is now known to have the unbelievable density of 100 million ton per cubic centimeter) concentrates mass and charge, whereas the diffuse cloud of surrounding electrons has relatively little effect on bombarding particles.

It was found experimentally that bombarding alpha

particles approached to within approximately 10^{-12} cm of the atomic center and that, when this close, they were repulsed with very great force. Recalling that the atomic diameter is of the order of 10^{-8} and that the nucleus is necessarily less than 10^{-12} in diameter (as alpha particles would not be repulsed if they actually entered the nucleus) it then becomes evident that the diameter of the atom is some 10,000 times greater than the nuclear diameter.

(a) Application of the Coulomb law. The "nuclear" atom provided a very satisfactory explanation of the observed phenomena of alpha scattering, but in doing so introduced a new point that required explanation. Visualization of all the protons as being gathered in the nucleus adequately explained the great Coulomb force of repulsion experienced by the doubly positively charged alpha particle as it approached the nucleus. But how to explain the failure of the nucleus to break apart as a result of the expected Coulomb forces tending to separate the protons?

(b) Breakdown of the Coulomb law. In seeking an explanation of the above difficulty the suggestion was made that the inverse square relationship (the Coulomb law) applied up to, but not beyond, a certain small distance from the nucleus. If this were true it would then be expected that some specifically nuclear force, nonelectrical and far more powerful than either gravitational or electrical forces, would take over and control within the nucleus itself. By bombarding nuclei of the lighter elements with high kinetic energy alpha particles the bombarding particles were caused more closely to approach the nucleus (because of lesser positive nuclear charge) than had been possible with heavier nuclei. These experiments established beyond doubt that the inverse square law breaks down in the vicinity of the nucleus

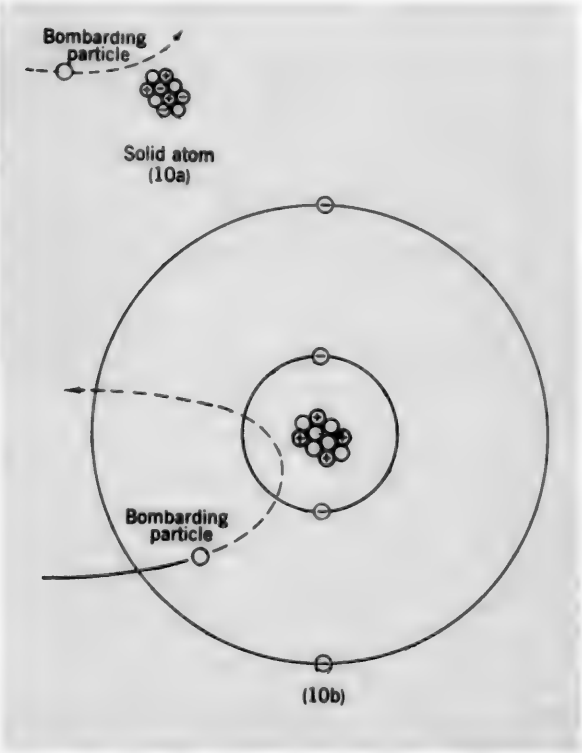


Fig. 10. The "solid" atom and the "nuclear" atom.

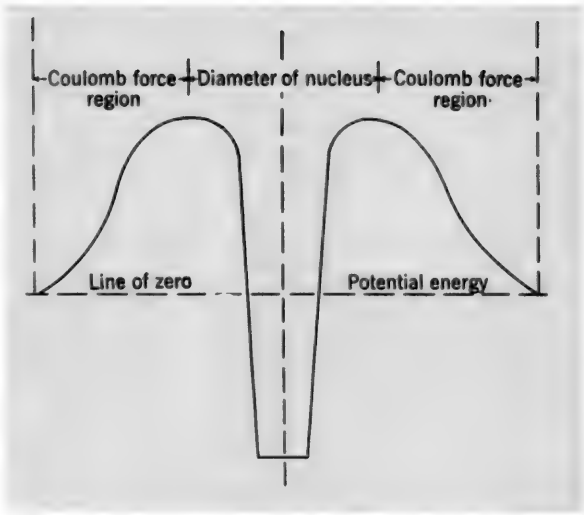


Fig. 11. The region of breakdown of coulomb forces.

and that, if the bombarding particle succeeds in penetrating the nucleus, the Coulomb force entirely vanishes and is replaced with a much more powerful force of nuclear attraction. Referring to Fig. 11, the approaching particle is subjected to increasing repulsion until, near the top of the "crater," the rate of increase of repulsion with approach distance decreases, finally reverses, and the bombarding particle is now held in the "well" of the potential energy crater where it is subjected to the specific nuclear "binding forces" will be presented later.
nuclear force of attraction. A quantitative discussion of

(c) Quantization of electron orbits. Returning now to the basic idea of the nuclear atom it is evident that if the electrons are to be pictured as out some distance from the nucleus the atom must be dynamic rather than static. A negatively charged electron a distance out from a positively charged nucleus would be subject to a Coulomb force of attraction and would "fall in" to the nucleus if it were not subject to some opposing force.

If each electron were revolving around the nucleus in a fixed orbit and at fixed velocity there would be a centripetal acceleration establishing an outward force such that

$$\text{Force}_{\text{out}} = m^1a = m^1v^2/r$$

But the Coulomb force of attraction sets up an inward force

$$\text{Force}_{\text{in}} = ee/r^2$$

Then for the electron to be in equilibrium

$$m^1v^2/r = e^2/r^2$$

or

$$v^2 = e^2/m^1r \qquad (14)$$

which establishes a functional relationship between orbit radius and the electron velocity needed to maintain dynamic equilibrium.

The next two steps in the visualization of atomic structure involve hypotheses which cannot, from simple observable facts, be justified except that they led to consequences which were consistent with experimental results. Just as mass had been quantized in the atom, electric charge in the electron, so it was now proposed

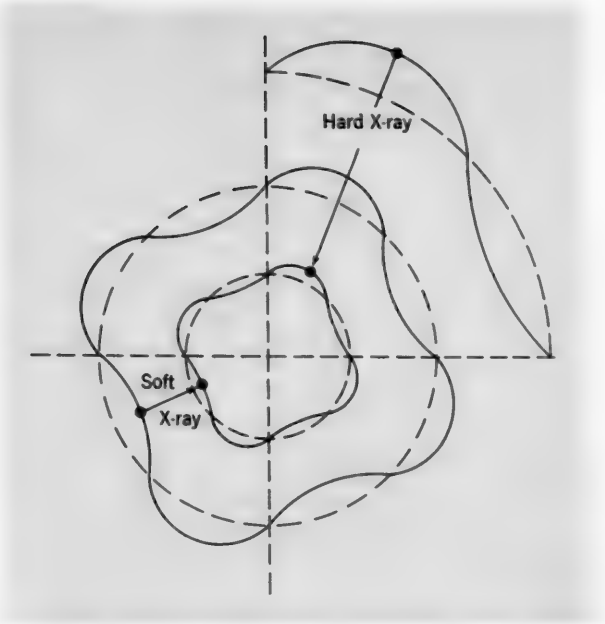


Fig. 12. The quantization of electron orbits.

the angular momentum of an electron, m^1vr, must also be quantized, giving

$$m^1vr = nK$$

where n is now a series of quantum numbers (1, 2, 3 . . . .) and K is a constant. The value of K was said to be Planck's constant, h (6.625×10^{-27}) divided by 2π: then

$$2\pi\, m^1vr = nh \qquad (15)$$

But equations 14 and 15 show immediately that quantization of the angular momentum has, as a consequence, quantization of the possible orbits in which an electron is "permitted" to rotate. Eliminating v between equations 14 and 15

$$4\pi^2(m^1)^2\ (e^2/m^1r)r^2 = n^2h^2$$

$$r = n^2h^2/4\pi^2m^1e^2 \qquad (16)$$

Substituting known values for m^1, e, and h, gives

$$r = 0.529 \times 10^{-8}\ (n^2)\ \text{cm} \qquad (17)$$

where r is the radius of each "permitted" orbit and n is the quantum number, equalling various integers as 1. 2. 3. 4 . . . . Thus, the allowed orbits for electrons are 1. 4. 9. 16. 25 . . . . . $\times$ 0.529 $\times$ 10^{-8} cm.

(d) The wave hypothesis. The nuclear atom and the quantization of electron orbits was (and is) an adequate hypothesis as applied to the simpler elements, but it was incapable of providing adequate explanation of the behavior of atoms which have many electrons. This difficulty was largely overcome by a proposal to visualize electrons as possessing some of the characteristics of waves as well as particles. For electromagnetic radiation, the quantization of energy had led to the photon as the smallest energy quantity associated with radiation of a given wave length. The equation was

$$\text{Photon energy} = h\nu = h\lambda \qquad (18)$$

where h is Planck's constant, ν is the frequency of the radiation and λ its wave length. From equation 18 it is evident that a larger quantity of energy is associated with high frequency short wave length electromagnetic waves.

In 1924 de Broglie predicted that the wave theory would be applied to the electron. According to this concept, an electron behaves not as a particle travelling in a fixed orbit, but rather as a wave occupying the region of that orbit. This concept had one immediately helpful consequence since it provided an explanation of the seemingly arbitrary inclusion of 2π as a multiplying factor in equation 15; thus, if an electron acts as a circular wave (refer to Fig. 12) it must both start and end at the same point on the circle; the need of 2π as a basic constant in the mentioned equation then becomes immediately evident.

De Broglie further expanded the application of the wave concept to particles by noting that, as applied to waves the fundamental energy, equation (18) could be written

$$\text{Photon energy/velocity} = \text{equivalent momentum} = h\nu/c = h/\lambda \qquad (19)$$

For particulate matter the above equation permitted expression of particle momentum in terms of a defined equivalent wave length, λ_e.

$$\text{Particle momentum} = mv = h/\lambda_e$$

or

$$\lambda_e = h/mv \qquad (20)$$

From equation 20, note that the equivalent wave length of a particle increases as the velocity decreases. Thus, an electron travelling at high speed would have a shorter equivalent wave length than one of the same mass travelling less rapidly. As will be shown later, the equivalent wave length is significant in explaining a type of radiation damage to materials which is said to be due to "Compton effect".

Electron Shells (a new significance of valence). Extension of the concept of orbital quantization led to the so-called Pauli exclusion principle which relates the number of electrons in particular orbits to four quantum numbers which relate spin angular momentum, magnetic splitting of spectral lines, deviation of the orbit from circular to elliptical form, and the basic quantum number which fixes the orbit. The Pauli principle is merely mentioned here as it involves an application of quantum mechanics beyond the intended level of this presentation. It is important, however, to identify the Pauli method as a hypothesis which has successfully explained the entire structure underlying the Periodic Table of the Elements.

One of the most significant deductions which follows from the Pauli exclusion principle is that any one orbit (or better, "shell") can be occupied by not more than $2n^2$ electrons where n is the quantum number of the shell in question. Thus, applying the $2n^2$ requirement, the theoretical number of electrons would be two in the inner shell, eight in the second shell, eighteen in the third shell and thirty-two in the fourth shell. Because of a complex system of subshells the actual number of electrons in shells in the heavier atoms exhibits some departure from this theoretically expected result. Under some circumstances, vacancies may temporarily occur in inner shells, but for stability all shells except the outer-

Fig. 13. Arrangement of the periodic table of the elements.

Group →		I	II	III	IV	V	VI	VII	VIII	0
Period	Series	1H 1.0080								2 He 4.0030
2	2	3 Li 6.940	4 Be 9.013	5 B 10.82	6 C 12.010	7 N 14.008	8 O 16.000	9 F 19.00		10 Ne 20.183
3	3	11 Na 22.997								
4	4	19 K 39.096								
	5									
5	6	37 Rb 85.48								
	7									
6	8	55 Cs 132.91								
	9									
7	10	87 Fr								

most will have their full permitted number of electrons.

The concept of electron shells permits giving increased significance, meaning and utility to the term valence. Valence is now regarded as indicative of the extent to which the outer shell of a particular atom is filled or partially empty. If the shell is filled the valence is zero. If (for n greater than one) the outer shell has only 1, 2, or 3 electrons its corresponding valence is $+1$, $+2$, or $+3$. If (for n greater than one) the outer shell lacks 1, 2, or 3 electrons of being filled the corresponding valence is -1, -2, or -3, respectively. As typical examples:

Hydrogen
2 electrons in n = 1 shell:
no others: valence +1

Helium
2 electrons in n = 1 shell:
no others: valence 0

Lithium
2 electrons in n = 1 shell:
1 electron in n = 2: valence +1

Beryllium
2 electrons in n = 1 shell:
2 electrons in n = 2: valence +2

Boron
2 electrons in n = 1 shell:
3 electrons in n = 2: valence +3

Carbon
2 electrons in n = 1 shell:
4 electrons in n = 2: valence +4

Nitrogen
2 electrons in n = 1 shell;
5 electrons in n = 2; valence −3

Oxygen
2 electrons in n = 1 shell;
6 electrons in n = 2; valence −2

Fluorine
2 electrons in n = 1 shell;
7 electrons in n = 2; valence −1

Neon
2 electrons in n = 1 shell:
8 electrons in n = 2: valence 0

Sodium
2 electrons in n = 1 shell and
8 electrons in n = 2 shell and
1 electron in n = 3 shell, so that valence is +1

Periodic Table of the Elements. When the elements are arranged in order of their atomic number it is found that a marked periodicity occurs with respect to many of their properties; thermal and electrical conductivity, thermal expansion, compressibility and many other properties are found to vary in a cyclic way. Fig. 13 shows, in form, a typical arrangement of the periodic table. The horizontal lines or periods group elements in terms of the electron shell in which they occur. Thus, the first period contains only the two elements, hydrogen and helium which suffice to fill the inner shell with electrons. The second period includes the weight of elements, from lithium through neon, which serve to identify all eight electronic states of the second shell. The third period starts with sodium which has only one electron in its n = 3 shell.

The vertical columns of the periodic table group the elements in terms of their valencies. Thus, hydrogen, lithium and sodium are all in same column, I, and all have valencies (refer to the previous tabulation) or +1. Helium and neon are both in column 0 and each is characterized by having a filled outer shell. thus zero valence.

(a) Explanation of inert gases. Examination of a complete periodic table (note that Fig. 13 is only a skeleton form) will show that all elements which have filled outer electron shells are characterized by the lack of chemical activity. A filled shell evidently means a very stable atom and one that will not readily undergo chemical reaction. The inert gases which appear in column 0 (helium, neon, argon, krypton, xenon, and radon) are good examples of this fact.

(b) The chemical significance of outer orbit electrons. The vacancies in the outer electron shell play a very important part in the formation—and maintenance—of chemical compounds. With respect to damage received by materials exposed to radiation from a nuclear reactor, it will be seen that ionic compounds are much less subject to decomposition than are compounds of some other types. An ionic compound, in terms of the periodic table arrangement, would be one composed of two atoms each with the same but opposite valence. Thus, potassium with a valence of $+1$ combines with chlorine having a valence of -1: this means that the one extra electron in the outer orbit of the potassium atom is utilized or "shared" by the chlorine atom which uses the extra electron to fill its own outermost shell.

(c) Bohr's concept of electron "jumps". An electron in space outside of a nucleus possesses an amount of potential energy equal to the work which would have to be done on the electron to move it (against the attractive Coulomb force Ze/r^2) from its selected position to infinity. For a hydrogen atom (having a single proton) Z is also equal to the electronic charge and the potential energy is then e^2/r (note that this term is for energy, not force, hence the first power of the electron orbit radius appears in the denominator).

In addition, the electron possesses kinetic energy amounting to (neglecting the relativistic mass increase) $\frac{1}{2}m^1v^2$. The total energy possessed by the electron is therefore

$$\text{Energy} = \tfrac{1}{2}m^1v^2 - e^2/r \qquad (21)$$

But in order for the electron not to "fall into" the nucleus, it has already been shown that

$$m^1v^2 = e^2/r$$

Then by substitution

$$\text{Energy} = -e^2/2r \qquad (22)$$

But substituting for r from equation 16 we obtain

$$\text{Energy} = -2\pi^2m^1e^4/n^2h^2 \qquad (23)$$

Evidently, therefore, the kinetic energy possessed by an electron is greater for larger diameter orbits, its potential energy is less, and it would consequently require less added energy to affect the removal of the electron from its orbit. Comparing the difference of energies associated with two electrons in orbits corresponding to quantum numbers n_1 and n_2

$$\text{Energy difference} = 2\pi^2m^1e^4/h^2[(1/n_1^2) - (1/n_2^2)] \qquad (24)$$

Bohr hypothesized that though electrons must travel in orbits of quantized radii they can nonetheless, on special occasion, literally "jump" from one allowed orbit to another. If, for example, a bombarding particle were to knock an electron out of an inner orbit, Bohr visualized that an electron from an outer orbit would jump or undergo transition to the vacancy. Since the energy associated with the outer orbit is greater than that associated with the inner it follows that the electron "jump" will be accompanied by a massless release of energy—as electromagnetic radiation—equal to the amount calculable from equation 24.

(d) Normal or "base" states and "excited" states. The Bohr visualization of electron jumps leads at once to the idea that a normal atom has extranuclear electrons which are in "base" states; that is, possessed of a substantial degree of stability and not likely to undergo spontaneous transition. As a result of atomic collisions or due to reception of energy from some other source (as from received gamma rays) one or more electrons temporarily receive more energy than corresponds to the normal state; these "excited" or "energetic" electrons then jump in a direction of greater stability. An outward jump requires that energy be absorbed in the process whereas an inward jump is always accompanied by the release of energy.

Production of "hard" and "soft" X-rays. Previously the production of X-rays was pictured as occurring as a result of bombardment of the anode by cathode particles. Now it is possible to visualize this procedure in quantitative terms. As the fast cathode particles enter the target (anode) they displace orbital electrons thereby leaving the affected atom in an excited state. In order to return to a stable condition the affected atom emits a photon of energy in the form of electromagnetic radiation in the range of wave lengths which correspond to X-rays. From equation 18

$$\text{Photon energy} = h\nu \qquad (18)$$

but the energy of the X-ray must be equal to the energy available from the orbital jump. Thus, from equations 18 and 24

$$h = \frac{2\pi^2m^1e^4}{h^2\nu}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \qquad (25)$$

Thus, the energy of the X-ray depends on the magnitude of the orbital jump. An electron which undergoes transition from one orbit to an adjacent inner one would correspond to a low energy photon or a "soft" ray (refer to Fig 12), whereas an electron which jumped from an outer orbit to one, two or three allowed radii farther in would correspond to a correspondingly large energy photon and this would then be described as a "hard" ray.

Sections dealing with Artificial Radioactivity, the Chart of the Nuclides, Nuclear Energy, Radiation Damage, Radiation Effects on Materials, and Health Physics will be published in the September issue.

HEATING PLANT OPERATING HOURS AND LOAD FACTOR

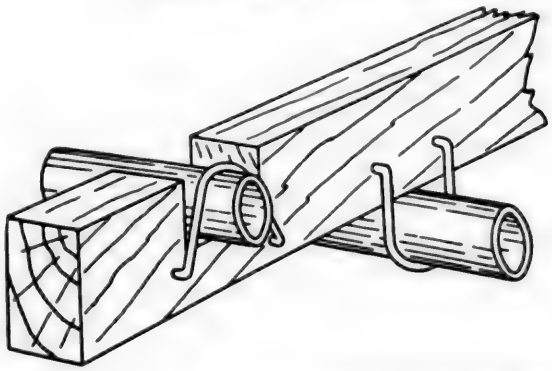
Location	No. of Hours Intermittent Heating Plant Operates per Normal Year	Seasonal Load Factor, Normal Year, Per-Cent
NEBRASKA (Concluded)		
Omaha–A	1973	34.4
Valentine–C	1884	29.4
NEVADA		
Las Vegas–C	1295	26.2
Reno–A	2067	29.1
Winnemucca–A	1915	27.8
NEW HAMPSHIRE		
Concord–A	2291	32.8
NEW JERSEY		
Atlantic City–C	1891	32.3
Newark–A	1940	33.4
Trenton–C	1870	32.6
NEW MEXICO		
Albuquerque–A	1625	30.5
Roswell–A	1098	22.0
NEW YORK		
Albany–A	2232	34.7
Albany–C	2021	32.9
Binghamton–A	2409	34.5
Binghamton–C	2103	32.7
Buffalo–A	2339	35.7
New York–LaG.–A	1849	32.5
New York–C	1868	32.3
New York–Cent. Pk.	1833	32.5
Oswego–C	2231	33.2
Rochester–A	2337	36.1
Schenectady–C	2258	35.5
Syracuse–A	2089	33.1
NORTH CAROLINA		
Asheville–C	1504	26.9
Charlotte–A	1395	28.5
Greensboro–A	1664	31.8
Raleigh–C	1338	27.6
Wilmington–A	1119	24.8
Winston-Salem–A	1623	31.3
NORTH DAKOTA		
Bismarck–A	2276	32.7
Fargo–A	2473	35.9
Williston–C	2179	31.1

Location	No. of Hours Intermittent Heating Plant Operates per Normal Year	Seasonal Load Factor, Normal Year, Per-Cent
OHIO		
Akron-Canton–A	2128	34.9
Cincinnati–A	1917	33.7
Cincinnati–C	1670	31.2
Cincin.–Abbe Obs.	1802	32.5
Cleveland–A	2217	36.8
Cleveland–C	2116	35.4
Columbus–A	1793	30.5
Columbus–C	1691	29.6
Dayton–A	2065	35.4
Sandusky–C	2163	36.2
Toledo–A	2050	33.1
Youngstown–A	2116	34.3
OKLAHOMA		
Oklahoma City–A	1347	28.2
Oklahoma City–C	1294	27.8
Tulsa–A	1324	28.3
OREGON		
Baker–C	2434	32.3
Eugene–A	2290	31.8
Medford–A	1814	28.0
Pendleton–A	1560	25.0
Portland–A	2018	28.7
Portland–C	1808	27.3
Roseburg–C	1794	26.7
Salem–A	2201	31.4
PENNSYLVANIA		
Allentown–A	2169	36.0
Erie–C	2099	33.9
Harrisburg–A	1938	33.5
Philadelphia–A	1797	32.0
Philadelphia–C	1669	30.5
Pitts. All. Airport	2055	35.1
Pitts. Gr. Pitt. Air.	2174	35.8
Pittsburgh–C	1865	33.2
Reading–C	1874	32.8
Scranton–C	2068	33.4
Williamsport–A	2022	33.3
RHODE ISLAND		
Block Island–A	2164	32.2
Providence–A	2263	34.8
Providence–C	2066	33.5

Location	No. of Hours Intermittent Heating Plant Operates per Normal Year	Seasonal Load Factor, Normal Year, Per-Cent
SOUTH CAROLINA		
Charleston–A	946	19.6
Charleston–C	847	21.4
Columbia–A	1066	24.4
Columbia–C	995	22.9
Florence–A	1203	26.8
Greenville–A	1331	27.6
Spartanburg–A	1457	30.2
SOUTH DAKOTA		
Huron–A	2232	35.1
Rapid City–A	2121	30.9
Sioux Falls–A	2219	34.5
TENNESSEE		
Chattanooga–A	1480	29.5
Knoxville–A	1329	26.5
Memphis–A	1155	25.2
Memphis–C	1112	24.9
Nashville–A	1297	26.5
TEXAS		
Abilene–A	1277	30.4
Amarillo–A	1395	25.5
Austin–A	910	25.1
Big Springs–A	1082	26.2
Brownsville–A	423	22.9
Corpus Christi–A	543	18.7
Dallas–A	836	21.5
Del Rio–A	676	20.4
El Paso–A	1151	26.2
Fort Worth–A	1028	25.8
Ft. Worth–A. Cart. Fld.	1022	25.8
Galveston–A	659	20.2
Galveston–C	644	19.6
Houston–A	741	21.3
Houston–C	676	20.4
Palestine–C	952	24.8
Port Arthur–A	805	22.2
Port Arthur–C	717	20.9
San Antonio–A	842	24.2
Waco–A	1076	28.4

Location	No. of Hours Intermittent Heating Plant Operates per Normal Year	Seasonal Load Factor, Normal Year, Per-Cent
UTAH		
Milford–A	1934	29.3
Salt Lake City–A	1875	29.6
Salt Lake City–C	1748	28.9
VERMONT		
Burlington–A	2516	37.3
VIRGINIA		
Cape Henry–C	1442	28.2
Lynchburg–A	1665	30.7
Norfolk–A	1659	32.0
Norfolk–C	1500	30.2
Richmond–A	1899	35.8
Richmond–C	1783	34.4
Roanoke–A	1665	30.7
WASHINGTON		
North Head	2786	31.8
Olympia–A	2646	30.2
Seattle–C	2136	28.8
Seattle-Tacoma–A	2535	30.8
Spokane–A	2355	32.6
Tacoma–C	2336	29.4
Tatoosh Isl.–C	2751	31.4
Walla Walla–C	1554	25.9
Yakima–A	2001	30.1
WEST VIRGINIA		
Elkins–A	1846	28.7
Huntington–C	1394	26.4
Parkersburg–C	1525	27.5
WISCONSIN		
Green Bay–A	2331	34.2
LaCrosse–A	2040	32.2
Madison–A	2225	34.6
Madison–C	2192	34.6
Milwaukee–A	2159	32.6
Milwaukee–C	2081	32.0
WYOMING		
Casper–A	2295	32.3
Cheyenne–A	2269	30.8
Lander–A	2346	32.8
Sheridan–A	1996	28.1

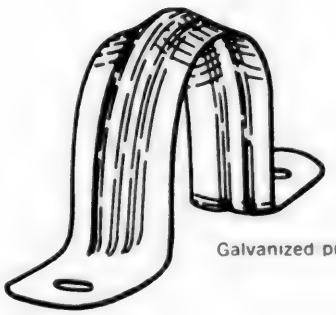
SIMPLE TYPES OF PIPE SUPPORTERS



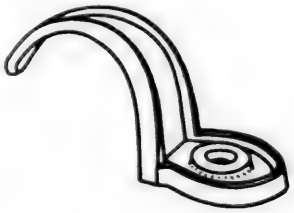
Support for holding a number of tubes against the underside of a joist

Left Two ways to use a wire pipe hook, points of hook are driven in beam

HOOKS FOR USE WITH WOOD BEAMS



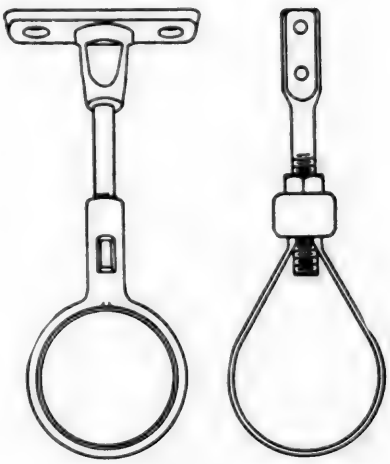
Galvanized pipe clip



One hole pipe clamp

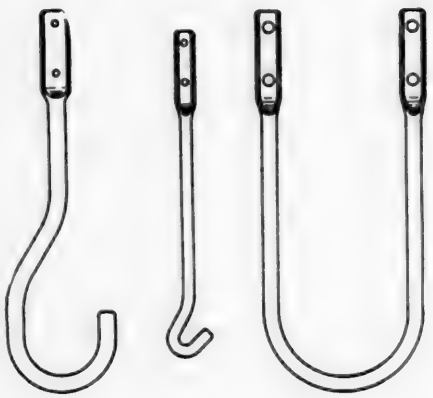
FOR LINES CLOSE TO UNDERSIDE OF FLOOR BEAMS WHERE PIPE IS NOT SUBJECT TO TEMPERATURE CHANGE

Flat offset hook for use on walls for pipe sizes from ½ to 3 in. dia, inclusive

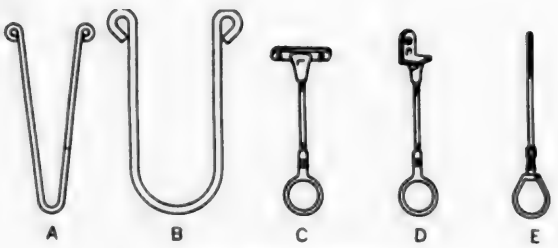


Left, adjustable clip ring hanger for ¾ to 2 in pipe. It permits 1½ in. Vertical adjustment. Right, steel band hanger with adjusting nut

SIMPLE TYPES OF PIPE SUPPORTERS

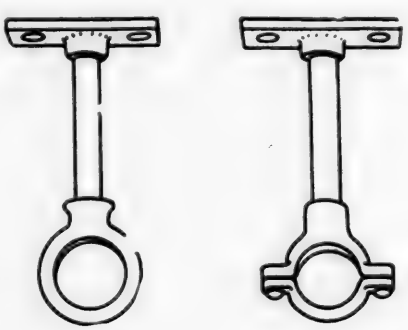


Left, steam pipe hanger for pipe lines 1 to 2 in. dia. Right, U-hangers for pipes 2 to 6 in. dia.



Common types of hangers for supporting sprinkler piping

A - U-type for branch lines.
B - U-type for cross and feed mains
C - Adjustable clip for branch lines.
D - Side beam adjustable hanger
E - Adjustable coach screw clip for branch line.



Steam and return lines may be supported by solid ring extension hanger, left, or split ring extension hanger, right

Solid and split ring swivel type hangers

Drawings Presented through Cooperation of J. E. York, S. Weymouth, Mass.

Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement.

NOTE: All advertisements are digested here except those received too late for inclusion. The Index of Advertisers lists all the advertisements in this issue.

Use the postcard below for catalogs, new equipment and materials, as well as Ad-Digest items.

UNIT HEATERS. Inside front cover. Made in horizontal and vertical models, these unit heaters are available in gas-fired or steam and hot water types. The gas-fired heaters are available in seven sizes, ranging from 25,000 to 200,000 Btu per hr. input. The steam and hot water types are available in 18 sizes from 35,600 to 275,300 Btu per hr, total heat delivered....**Item 123**

FUME REMOVAL FAN. Page 1. A fan with a bifurcated housing is applied by this company to fume removal problems. A bulletin is available containing complete data on the use of the fan for exhausting corrosive fumes. ----------**Item 124**

PERIMETER HEATING. Page 2. Perimeter heating systems, with steam or forced hot water, are made by this company to create a barrier of warm air against incoming cold along exposed walls. The heating system can be combined with air conditioning for year-round heating and cooling. Information is available. ----**Item 125**

COPPER-LINED HEATERS. Page 4. The copper-lined heaters offered by this manufacturer have rolled joints every 12 inches around the full circumference of the lining to allow for longitudinal expansion. Separate hydrostatic and pneumatic tests are run to guarantee that the lining will be leakproof. Sample specifications and catalog are available. ----------**Item 126**

WROUGHT IRON PIPE. Page 9. The iron silicate fibers which give wrought iron its resistance to corrosion also enable it to take a heavier coating of zinc. A bulletin is available discussing galvanic protection and reviewing a variety of wrought iron pipe services. ----------**Item 127**

FLUSH VALVES. Page 11. Diaphragm type flush valves made by this company were installed in a surgical suture factory in accordance with specifications. A handbook and catalog are available with charts, formulae, piping, and installation details for exposed, concealed, and special flush valve installations. ----------**Item 128**

HEAT EXCHANGE PROBLEMS. Page 13. Assistance in solving heat exchange problems are offered by this manufacturer of lightweight extended surfaces through its heat transfer engineers. This assistance is backed by the research and production facilities of the company. Information is available. ----------**Item 129**

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

STEAM HEATING SURFACE. Pages 14-15. Steam heating surfaces are manufactured by this company with trombone-shaped distributing tubes that serve two adjacent condensing tubes from a single supply header connection. The units offer uniform discharge temperatures and condensate freeze protection under modulated steam control. A report and a publication are available. ----------**Item 130**

FLOAT AND THERMOSTATIC TRAP. Page 16. A float and thermostatic trap is made by this company in either ¾- or 1-in. pipe size for 0-15 psi and 15-125 psi. Trap removes air and condensate from steam mains, branches, risers, unit heaters, and coils. Catalog of heating specialties is offered. ----------**Item 131**

CONTROL SYSTEM. Page 17. A dual system of automatic temperature control is offered by this company as a solution to the heating and ventilating problems of the modern school. After school hours, thermostats operate at lower temperatures, but one may be restored to normal temperature without changing the settings of the others. Folder is available....**Item 132**

STEEL VALVES. Page 18. For twenty years, this company's 600-lb gate valves have been operating on a main header with working pressures at 400 psi, 750 deg F in a sugar refinery's power plant. Service records like this result from internal valve quality. Information is available. ----------**Item 133**

STEAM BOILERS. Page 19. Boilers manufactured by this company provide steam for air conditioning and heating a large office building. Boilers are available in standard sizes to 40,000 lb per hr of steam at pressures to 235 psi. Bulletin is available. ----------**Item 134**

AIR CONDITIONING EQUIPMENT. Page 22. Air conditioning equipment made by this manufacturer controls the climate in one of America's most modern research centers. In work with rabbits, temperatures on the laboratory never vary more than one degree. Central systems and packaged units are offered. Information is available. ----------**Item 135**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121	122										
123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166
167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188
189	190	191	192	193	194	195	196	197													

PLEASE PRINT July H-56

This service available only to U. S. and Canadian readers.

Name ..... **Title** .....

Firm .....

Nature of Firm's Business .....

Street .....

City ..... **Zone** ..... **State** .....

This card is void after Oct. 1, 1956

Ad-Digest

SPRAY NOZZLES. Page 23. A new peak in spraying efficiency is obtained with these non-clog nozzles, available in either cone spray or fan spray types. The former is for cooling, re-cooling, washing, rinsing, air conditioning, and similar operations; the latter is for surface washing. The cone type is available in three types. Spray nozzle bulletin available. ---------**Item 136**

AIR-COOLED CONDENSERS. Page 24. The addition of a temperature control to this company's air-cooled condenser makes the operation of an air conditioning system fully automatic and eliminates manual changeover. The condensing system provides predetermined minimum heat pressure up to the expansion valve. Information is available. ---------**Item 137**

GALVANIZED SHEETS. Page 25. Galvanized sheets are made by this company to take every roll, bend, crimp, and fold without flaking or chipping the coating. Galvanized sheets, furnace pipe, snap lock or closed seam perimeter or air conditioning pipe, and accessories are offered by the company. Information is available. ----------**Item 138**

AIR CONDITIONING VALVES. Page 26. Solenoid valves, thermostatic expansion valves, and filter-dried combinations are offered by this company for all air conditioning installations. No matter how large or small the system, one of this company's hook-ups is available from catch-all to distributor. Information is available. ----------**Item 139**

COAL FUEL. Page 27. Up-to-date coal burning equipment can give 10 to 40% more steam per dollar; automatic coal and ash handling systems can cut labor costs; coal is safe to store and use; and coal is plentiful. Case histories of coal burning economies are available. **Item 140**

GLASS FIBER INSULATION. Page 28. Insulation application time was reduced 20% in one plant because this company's fiber glass insulation is held in place with adhesive. Its light weight characteristics make it easy to handle. Consultation on insulating problems is offered. ------**Item 141**

UNIT HEATERS. Page 29. A line of unit heaters with a wrap-around rectangular heating element are made by this company for steam or hot water in both vertical and horizontal applications with capacities from 34,000 to 684,000 Btu per hr. A publication on the heaters is offered. **Item 142**

COPPER TUBE. Page 30. Copper tube is offered by this company for radiant heating because it unrolls easily into position on ceiling or floor, comes in 60- and 100-ft lengths, and can be connected with simple soldering techniques. The tube is color-coded for identification of type and size. Information is available. ----------**Item 143**

SPREADER STOKERS. Page 31. A spreader stoker that automatically cleans the fuel bed and discharges the ash continuously at the front is made by this company. It operates without smoke through a wide load range. Bulletin is available. ----------**Item 144**

HIGH VELOCITY. Between pages 32-33. The high velocity or distribution systems designed by this manufacturer can be used with smaller than conventional ducts. The units save space when insalled in hospitals, office buildings, schools, and similar structures. Round, square, and straightline diffusers are made by the company. New Products bulletin and selection manual is available. ----------**Item 145**

PLUG-TYPE VALVES. Page 33. Plug-type valves for throttling steam are made with a 500 Brinell, stainless steel seat for maximum resistance to galling, cutting, abrasion, and erosion. The stainless steel plug is securely fastened to the spindle with a bronze locknut. The valves are available in globe and angle in 150, 200, and 300-lb. sizes. Information available. ----**Item 146**

HEATING SYSTEM MOTORS. Page 34. Electric motors for driving heating system circulating pumps are manufactured by this company to assure reliable service and quiet operation. They are available with resilient bases in both sleeve and ball bearing types in ratings through 5 hp with a variety of enclosure types and mountings. Information is available. ----------**Item 147**

REFRIGERANTS' CHARACTERISTICS. Page 35. The characteristics of this company's refrigerants are compared with other basic refrigerants in tabular form. The chart may be cut out and added to fact files. Information is available. **Item 148**

HEATING-COOLING UNITS. Page 38. Heating-cooling units are made by this company for air conditioning existing buildings and new construction. They offer individual room control and dehumidify, clean, and circulate fresh air. Bulletin is available. ----------**Item 149**

PACKAGED AUTOMATIC BOILERS. Page 39. The sale of one of this company's 500-hp packaged automatic boilers to a food processing plant led to the purchase of four more by other companies in the area. A completely factory-assembled and fire-tested unit is offered on a purchase plan by the company. Bulletin is available. ----------**Item 150**

ROOF EXHAUSTERS. Page 40. An acceptable noise level is established for this company's roof exhausters by pre-testing. U-springs suspend the power unit so that vibration is absorbed; motor and plate are balanced integrally. Information is available. ----------**Item 151**

THERMOSTATIC CONTROL SYSTEM. Page 41. The thermostatic control system designed by this company helps provide a comfortable atmosphere for learning in a new architectural school building. The company offers consultation on temperature and humidity control problems. Information is available. ----------**Item 152**

MOTOR-COMPRESSOR SETS. Page 42. Motor-compressor sets with suction cooling are made by this company for packaged air conditioners. Freon-12 models are available in four sizes to 7½ hp, and Freon-22 models are available in three sizes to 10 hp. Information is available. --**Item 153**

SOLENOID VALVES. Page 43. A complete line of solenoid valves is offered by this company for liquid, suction, or hot gas discharge for brine, water, steam and air refrigeration service. The valves may be serviced without breaking electrical or line connections. Technical bulletins and a condensed catalog are available. **Item 154**

RECESSED AIR CONDITIONER. Page 44. A recessed, year-round air conditioner that allows room-by-room installation and control is offered by this company for both commercial and institutional buildings. The unit uses central steam or hot water facilities and, for cooling, is equipped with its own refrigeration cycle. Literature is available. ----------**Item 155**

COOLING TOWERS. Page 45. Induced draft cooling towers are being equipped by this company with permanently sealed and lubricated fan bearings to eliminate moisture and periodic greasing. The towers have 4-blade, deep-pitch fans to cut down the noise level. Bulletin is available. ----------**Item 156**

Postage Will be paid by Addressee

No Postage Stamp Necessary If Mailed in the U. S.

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 53, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

AIR CONDITIONING, HEATING AND VENTILATING

93 WORTH STREET

NEW YORK 13, N. Y.

AD-DIGEST SERVICE

Ad-Digest

DUCT FANS. Page 46. Two of this company's 24-in. belt-drive duct fans remove welding smoke and paint fumes along a high speed barrel production line. Single, double, or multiblade models are available from 12 to 60 in. for moving flammable fumes, corrosive elements or abrasive dust. Bulletin is available. ----------**Item 157**

TANKS AND LININGS. Page 47. Special tank fabrication problems are solved by this company which builds tanks of steel, stainless steel, copper, nickel, Monel, and all clads. Its lining department offers rubber, lead, copper, and plastic linings. Reference catalog is available. --**Item 158**

TEMPERATURE REGULATORS. Page 48. The advantages of packless construction in temperature regulating valves include the elimination of repacking problems, lower maintenance, and accuracy of regulation. This company's temperature regulators are guaranteed not to wiredraw. A bulletin with piping layouts is available. ----------**Item 159**

COOLING TOWERS. Page 49. A low silhouette cooling tower is manufactured by this company for intermediate capacity cooling in institutional and commercial installations. The cooling towers are selected for a great many of the jobs that fall in their capacity range. Information is available. ----------**Item 160**

SNOW MELTING SYSTEMS. Page 50. Snow melting systems eliminate winter hazards around residences, hotels, and other large buildings. Steel pipe is made by this company for snow melting applications with uniform bending and strong welding qualities. Information is available. ----------**Item 161**

LINE OF PUMPS. Page 51. The pumps included in this company's line feature quiet operation, low inlet connection, and accessibility for inspection. The low inlet connection is suited to the pump's specified capacities and pressures. Bulletins on each pump in the line are available. --**Item 162**

COPPER WATER TUBE. Page 105. In a residential installation, 1740 ft. of this company's copper water tube was used for hot water heating and air conditioning lines. Copper water tube can be used for hot and cold water lines, radiant panel heating, underground service lines, drainage, waste, and vent lines. A 28-page booklet on building products is available. ----------**Item 163**

UNDERGROUND PIPE INSTALLATION. Page 109. Insulation for hot underground pipes is made by this company in three types for three different temperature ranges. It forms three zones of protection against heat loss; needs no housing or mechanical sheath; and only requires normal pipe spacing. Information is available. ----------**Item 164**

SIDEWALL GRILLES. Page 111. Sidewall grilles are designed by this company to give adjustable air pattern and rapid diffusion without air stream drop or excessive air motion. Performance data permit the engineer to create required conditions without guessing. A variety of types is available. ----------**Item 165**

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

STEEL PIPE. Page 113. Uniform threading of this company's pipe makes jobs easier and quicker. Couplings, tees, and elbows can be put on smoothly and tightened up to form a leakproof joint. Information is available. ----------**Item 166**

OIL-FIRING EQUIPMENT. Page 115. Three of this company's forced draft burners with matched boilers supply hot water and steam to a new luxury hotel. Oil burners are available for single or dual fuel firing in a wide range of sizes. A 20-page illustrated catalog is available. ----------**Item 167**

PACKAGED AIR CONDITIONERS. Page 117. Twenty-two of this company's packaged air conditioners in various sizes amounting to 180 tons were selected for a business center in Dallas. Both horizontal ceiling models and floor models may be used singly or in multiple. Information is available. ----------**Item 168**

CAST IRON BOILER. Page 119. A cast iron boiler has been designed by this company for horizontal rotary oil burners for commercial, institutional, and industrial installations. The cast iron sectional construction offers easier erection and requires less space. Bulletin is available. ----------**Item 169**

DUCT NOISE SILENCERS. Page 121. Sound trap units are made by this company to fit any size or shape of duct and to eliminate frequencies in the audio-frequency range to silence entire systems or selected outlets. Four series cover applications from offices to recording studios. Booklet is available. ----**Item 170**

REGISTERS AND GRILLES. Page 123. A line of registers and grilles are made by this company for the control of warm air heating and for year-round heating and cooling. The line includes single damper forced air registers, ceiling air diffusers, perimeter baseboard diffusers and registers, and perimeter floor registers. A catalog of the complete line is available. ----------**Item 171**

PIPE RACKING CHANNELS. Page 125. A method of pipe racking is offered by this company with six channels, clamps, hangers, concrete inserts, rollers, and other accessories. The method requires no drilling, welding, or riveting for supporting steam, gas, light conduit, air conditioning, or heavy water lines. A 78-page catalog is available. ----------**Item 172**

SPACE HEATERS. Page 127. Six of the company's 1.5 million Btu per hr space heaters, installed in groups of three, operate automatically to provide heat as needed, by a 10-story high arena. A temperature-humidity control system operates the heaters or a series of exhaust fans. Literature is available. ----------**Item 173**

DRAFT INDUCERS. Page 129. For the boiler plant of a modern hospital, this company's draft inducers were selected. They provide positive draft for boilers or furnaces independently of weather conditions to provide higher fuel-burning efficiencies. Bulletin is available. --**Item 174**

CIRCULATING PUMPS. Page 131. A line of close-coupled and flexible-coupled pumps is made with capacities from 5 to 400 gpm and heads from 10 to 190 ft for water supply systems, cooling tower circulating, air conditioning systems, hot and chilled water circulating, pneumatic water systems, and booster service. Two bulletins are available. ----------**Item 175**

POWER BOILERS. Page 133. Power boilers are manufactured by this company to satisfy the demands of institutional, apartment, office and industrial buildings. The company also furnishes low pressure boilers for heating purposes. Information is available. ----------**Item 176**

ICE BANKS. Page 133. Sweet water ice banks are designed by this manufacturer to deliver tons of 32- to 34-deg F ice water for recirculation through air cooling coils in air conditioning systems. Designed for use with Freon, methyl chloride, or ammonia, the banks may be added to existing systems for increased capacity. Catalog is available. ----------**Item 177**

INQUIRY CARD

Circle below item numbers on which you wish catalogs or further information.

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Ad-Digest

AIR RECOVERY. Page 135. To prevent beer from being affected by polluted air, a brewery installed this company's air recovery system to provide pure uncontaminated air. The air recovery system can also reduce costs of air conditioning and ventilating systems. Information is available. ---------- **Item 178**

UNIT AIR CONDITIONERS. Page 135. Unit air conditioners are furnished by this manufacturer in sizes of 3, 5, and 7½ hp. They have insulated cabinets; large cooling surfaces; insulated condensers; and conservative ratings. Bulletin is available. ---------- **Item 179**

INTERIOR FIRE PROTECTION. Page 136. Interior fire protection equipment is offered by this manufacturer with accurate quotations from its factory, delivery as promised, and quick installations. The company makes an entire line of equipment. Information is available ... **Item 180**

WATER COOLER GUIDE. Page 137. A new guide to water cooler selection, published by this company, answers such questions as: Type required; kind needed; capacity necessary; how many; and location. It also considers how much water is needed by office, factory, and foundry workers. ---------- **Item 181**

AIR DIFFUSERS. Page 137. Square and rectangular air diffusers are equipped by this manufacturer with built-in diffusing vanes arranged in unlimited louver patterns. A catalog showing how to select the proper size and pattern for particular job conditions is offered by the company. ---------- **Item 182**

FLEXIBLE DUCT CONNECTORS. Page 138. These one-piece, factory-assembled metal-to-material duct connectors unroll flat. Any type of flexible duct connectors can be fabricated by just measuring and cutting. Available in 25, 50, or 100-ft. rolls in 3- or 6-in. widths. Catalog and specification sheet are available. ---------- **Item 183**

ALUMINUM VENTILATOR. Page 139. A continuous aluminum ventilator, with a 72-in roof opening, exhausts smoke and heat from metallurgical processing equipment in one plant. Center hinge dampers and a fixed top form a cone-shaped air flow section. Data book on roof ventilators is available. ---------- **Item 184**

WATER HAMMER ABSORBERS. Page 139. The shock absorbers made by this company eliminate noisy water hammer in pipe lines and prevent damage to valves, fittings, and pipe lines. Shock absorber manual is available. ---------- **Item 185**

STEAM HEATING COILS. Page 139. Steam distributing tube heating coils of this manufacturer have all tube outlets from the header extruded to provide double thickness for tube insertions. The tubes are fabricated from 0.035-in. copper; nipple connections are brass. Catalog is available. ---------- **Item 186**

BOILER WATER LEVEL CONTROLS. Page 140. Boiler water level controls are available from this manufacturer for pressures to 600 psi and temperatures to 750 deg F, for single or multiple-stage control with as many as three separate switching actions. Special units are made for more extreme requirements. Catalog is available. ---------- **Item 187**

POWER ROOF VENTILATORS. Page 141. Power roof ventilators are available from this company with air capacities from 550 to 65,000 cfm belt and direct drive. Seven top view sizes are available in 6-in. increments; height varies in 5½-in. increments. Booklet with design, construction and performance data is available. ... **Item 188**

AIR CONDITIONING SYSTEMS. Page 141. A wide variety of installations of this manufacturer's air conditioning systems have been made in Florida hotels, country clubs, and shopping centers. Three different systems are offered to meet any requirements. Catalogs are available. ---------- **Item 189**

AUTOMATIC SHUTTER. Page 141. An automatic shutter for unit blowers is self-contained in an adapter sleeve for attachment to the blower. Weather stripped, the shutter has light gage aluminum louvers with felt silencer strips. Catalog, circular, and prices are available. ---------- **Item 190**

HUMIDITY CONTROL. Page 142. A method of controlled humidity air conditioning has been devised by this company to remove moisture from air by contact with a liquid in a small spray chamber. Heating or cooling is done as a separate function. Information is available. ---- **Item 191**

ROOF VENTILATORS. Page 143. A complete range of units and sizes for every ventilating problem is offered by this manufacturer of roof ventilators. The ventilators are available for supply or exhaust purposes. Information is available. ---------- **Item 192**

COOLING TOWERS. Page 144. A complete line of mechanical and natural draft cooling towers is offered by this manufacturer. Overall height of the largest capacity tower is only 7½ ft. A company engineer will help select the right tower for particular requirements. Information is available. ---------- **Item 193**

GAS-OIL BURNERS. Page 146. Seven models of gas-oil burners are made with capacities from 100,000 to 4,600,000 Btu per hr on gas and from 1 to 33 gph on oil for boilers from 2 to 100 hp. The burners can be automatically or manually switched from gas to oil and have electronic safety controls. Specification sheets and prices are available. ---------- **Item 194**

ROOF VENTILATORS. Page 147. A line of power roof ventilators has been designed by this company for commercial, industrial, and institutional ventilating requirements. The line includes three different models in sizes from 12 to 72 in. and capacities to 80,000 cfm. Bulletin is available. ---------- **Item 195**

RELIEF VALVES. Inside back cover. Relief valves for Freon and similar refrigerants and for ammonia are constructed in accordance with the standards of the ASME. They are made in straight-through and angle types and are stamped NB to indicate National Board Certification of their capacities. Data sheet showing capacity ratings is available. ---------- **Item 196**

WATER LEVEL CONTROLS. Back cover. A line of water feeder cut off combinations is offered by this company to guard against low water levels in boilers. Combinations are available for steam boilers from 25 psi to higher pressure boilers up to 75 psi for both steam and hot water heating. Catalog is available. ---------- **Item 197**

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AD-DIGEST SERVICE

Coliseum Has Air Ducts Placed in Floor Slabs

Considerable savings in construction costs and space resulted in New York's Coliseum from placing most of the branch ducts in concrete floor slabs. Details of this design are described as well as the air conditioning features.

A RADICAL departure in the design of big building air conditioning systems was used in New York's new, massive four-level Coliseum by locating about 75% of branch ductwork directly in concrete floor slabs over exhibit spaces, with ceiling air diffusers forming the core of 8 ft square fluorescent lighting fixtures.

This basic principle, to a limited extent employed previously in the design of air conditioning for housing units, was adapted by the consulting mechanical engineers to suit the Coliseum's need for an attractive ceiling without the conventional use of acoustical paneling. Cost of a hung ceiling, deemed unnecessary other than to mask ductwork and electrical outlets, may have added $100,000 or more to the air conditioning and lighting bill. It also would have reduced ceiling height, a feature important in the planning of many types of exhibits the hall hopes to accommodate.

Design of Ducts

Installation was accomplished by fabricating ductwork in the early stages of building construction, waterproofing these ducts, and anchoring them to structural steel over formwork before concrete was poured. Ducts were made of 1-inch thick marine paneling. To protect these ducts from being crushed, sheet-metal shields were placed around them and removed as concrete was poured.

Ducts taper down from 15 inches wide by 5 inches deep at the connection end to 8 inches wide by 5 inches deep farther in the slab. Each branch duct has a maximum of four outlets. Five-inch flexible conduit connections carry air through sound boxes, from which the air passes down through circular diffusers that look from below like part of the lighting fixtures. Transite panels, used to cover duct connections and sound boxes, and to fill out an area of about 4 ft square between the diffuser and the inner edge of the surrounding rows of lights, are removable without the use of heavy tools.

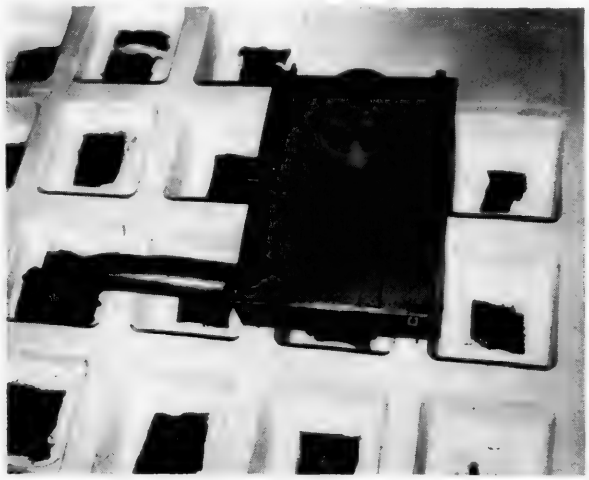


Fig. 1. Directly in the concrete floor slab, is the branch ductwork. A 5-inch flexible conduit is attached to the sound box which forms part of the air outlet.

Fig. 2. Glass panels cover fluorescent tubes for lighting. Harmonizing transite panels are over ductwork connections between diffusers and lights and combine to form attractive ceiling fixtures.

The waffle pattern of the ceiling is formed by ribs uniformly set 2 ft apart and recessed to a depth of about 6 inches, except above lighting fixtures. There, a cross-section of four ribs has been dropped out completely to form an open area of approximately 4 ft square so that air conditioning connections could be unobtrusively brought through.

Slab location of branch ductwork has been carried out in all principal exhibit areas except a second-floor well, where open ductwork has been tucked in above truss spaces, and numerous small exhibit offices and auxiliary meeting rooms, where hung ceilings have in most cases been installed.

Exhibit Space Details

The four-level hall, offering 300,000 sq ft net exhibit space, consists of four exhibit floors, with surrounding mezzanines and galleries, and intermediate floors housing offices and auxiliary rooms. The first exhibition floor, with a 20-foot clear ceiling height, is at street level; it

Fig. 3. Ceiling pattern formed by the air conditioning and lighting fixture as seen on the first exhibition floor.

contains 64,400 sq ft exhibit space. Around its outer dimensions is an intermediate floor. The second exhibition floor offers 88,500 sq ft. It also has a minimum ceiling height of 20 ft, but its core portion is a well having a clear height of 60 ft, with a floor measuring in excess of 150 ft in each dimension. The well is surrounded by two mezzanines. The first has 70,550 sq ft exhibit space, the second 70,000 sq ft. Around the outer dimensions of the second exhibition floor is an intermediate floor between it and the first mezzanine.

Architecturally an integral part of the Coliseum structure is a 20-story office tower with more than half a million sq ft of rentable space. As much as possible, it has been conceived as an entity separate from the exhibition hall.

Triborough Bridge and Tunnel Authority, owners of the Coliseum, are banking on the $5½ million air conditioning installation (total for Coliseum and tower) to attract exhibitors during New York's typically hot and humid summer season. For example, at least six important shows are scheduled to take place this year during what are normally considered off-season months for business in New York.

Refrigeration Plant

With this in mind, as well as the fact that only a relatively small part of the total exhibit space may be in use at a particular time, the Coliseum's engineers have built a central-system air conditioning installation, operating from a 4,050-ton Carrier refrigeration plant, that is as flexible as possible. It is one that makes the most efficient use of the total refrigeration available (2,500 tons for the exhibition hall alone) and gives operators instantaneous control over the multitude of climatic factors that may influence the comfort of as many as 35,000 people at one time.

The refrigeration plant, which consists of two Carrier drive-through type centrifugal machines and two 775-ton Carrier centrifugals, is actually two plants in one. In terms of total capacity, it is one of the most powerful refrigeration plants that has been installed in a New York building up to now. Drive-through, in simplified terms, meaning that for installation and operating economies, twin compressors are operated off the single turbine on each machine.

The larger machines each provide 2,500 gpm of chilled water for cooling about 600,000 cfm of primary air, distributed through the Coliseum proper by zoned air-handling units, each of which is equipped with an exhaust fan. The smaller centrifugals furnish chilled water, each at a rate of 1,550 gpm, for the separate perimeter and interior systems air conditioning the Coliseum's 20-story office tower; these distribute primary air at a rate of about 310,000 cfm.

Turbine drives on the compressors are powered by high-pressure district steam at 125 psi. And although all four machines, as well as most of the air-handling apparatus rooms, are located in a single gallery-like deck just below the Coliseum's roof, air conditioning systems for exhibit spaces and offices were designed to be operated independently. Centrifugals are, however, interconnected in the event there is need for emergency switchover. A ten-cell cooling tower, capacity 4,100 tons, separated from the refrigeration plant by only a few yards, is located outdoors on the exhibition hall's roof—a feature which saved many thousands of dollars in cost of condenser water piping. Chilled water piping costs have similarly been kept down by putting all but two of the Coliseum's and four of the office tower's air-handling apparatus rooms alongside refrigeration machines.

Apparatus Rooms

Because of the many subdivisions into which the Coliseum's total exhibit space can be tailored to accommodate shows of all types and sizes, or perhaps one big show with several smaller ones simultaneously, separate zoned air-handling apparatus rooms—about 35 in all—are used in the building's air conditioning. This insures the most economical operation of the refrigeration plant against the possibility that only scattered sections, or relatively small exhibit areas, may be in use at a particular time. Maximum temperature control thus is provided over conditioned air going into particular spaces through variation in temperature of supply air within a maximum range of 25 deg.

Apparatus rooms are zoned to provide cooled, dehumidified and filtered air to any exhibit areas that are in use.

In the big, open areas, air of a single temperature is fed at a velocity from 3,500 to 4,000 fpm through thin, high-pressure supply ducts, from which it is moved laterally through branch ductwork located in the slab, and then

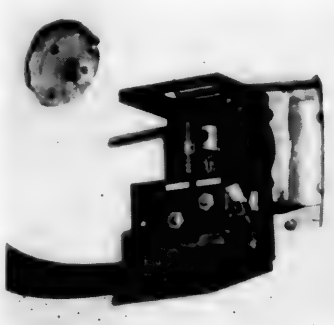


Fig. 4. Photoelectric smoke control device with the cover removed. Each of the exhibition halls has this control for the air handling apparatus installed.

diffused at a gentle rate downward into the space. Return air outlets are located along the peripheries of exhibit areas, in walls or supporting columns.

Air circulation is more of a problem in small meeting rooms, enclosures to be used by the press or for special functions, foyers and the like. For closer control over temperatures in these smaller spaces, where ductwork for the most part runs above hung ceilings, a dual duct system of cool and warm air supply is very largely provided. Dampers regulate the mixture of a proportion of warm air with the cool air, allowing for considerable variation in temperature of the air delivered to rooms in the same air distribution network. There may be a half-dozen or more varying-sized rooms served by the same air-handling apparatus.

Office Tower

Air conditioning for the 20-story office tower is operated from refrigeration equipment located in the same place as that for the exhibit hall. It combines a high-pressure, two-zone Conduit Weathermaster System for perimeter areas (about 16 ft in from windows) with a four-zone dual-duct interior system.

Air handling apparatus rooms for perimeter areas, delivering high velocity air through 8-inch vertical high-pressure conduit risers located between pairs of windows, to under-the-window type air control cabinets, are situated in a penthouse and on the tenth floor.

In operation, each cabinet receives a high percentage of primary air from a central source. Passing through ejector nozzles, the air streams induce a secondary flow of room air to enter the units through the front of cabinets. This secondary air passes over coils through which centrally-refrigerated chilled water or, in winter, heated water is flowing. The water flow is regulated thermostatically, and this, in turn, regulates the temperature of the air going into the room. The mixture of primary and secondary air is discharged into the room through a grille in the top of the cabinet.

For interior zones, a dual-duct system has been provided, with mixing boxes installed at takeoff points in the main supply ducts at each floor. The system is served by two air handling units in the penthouse and two in the central air conditioning gallery in the exhibition hall. Distribution is for the most part through ceiling diffusers which form a part of hung ceilings.

Centralization of air handling equipment has resulted in a great savings of rentable space.

Automatic Controls

An unusual number of automatic controls has been built into the Coliseum air conditioning system. Designers, aware that smoke conditions are likely to be extreme at times in buildings of this nature, have provided an electronic watchdog to take care of the problem.

It consists of a photoelectric cell mounted on the exhaust duct at the fan in each air handling apparatus room serving exhibition spaces. In the event that accumulations of smoke in a space are more than can be carried off through ordinary air circulation, the smoke control device will automatically shut off the air supply fan, turn on the exhaust fan, and flash both a visible and audible warning at control boards. When the space has been adequately

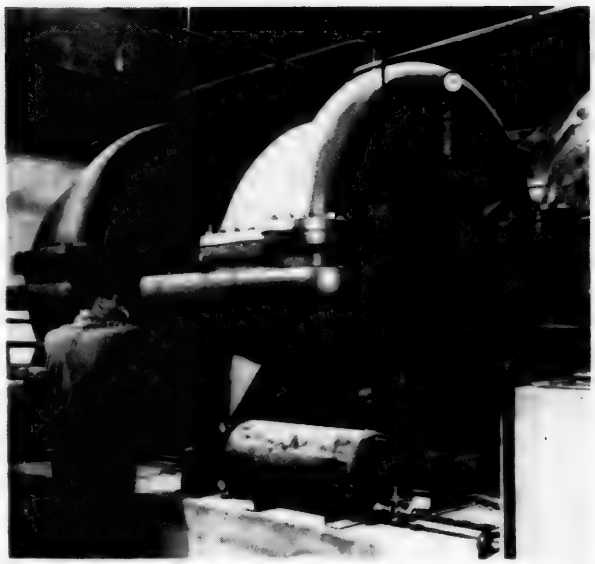


Fig. 5. One of the two Carrier 1,250-ton centrifugals to cool the Coliseum exhibition hall. Two smaller centrifugals are used to air condition the office tower. In all, there are 4,050 tons of refrigeration.

flushed of smoke, the air handling equipment will automatically return to normal operation.

The master instrument panel controlling individual components of the vast and complicated systems that serve both the exhibition hall and tower is one of the most elaborate ever conceived for an air conditioning installation. And keyed into it are sub-control panels, located remotely, one on each of the four principal floors of the exhibition hall. Thus, an operator has at his fingertips, through remotely located recorders and controllers, practically all the information he might need to know to keep the systems running at top efficiency, and adjustment and maintenance problems are minimized.

The master board registers visible or audible warnings, and in some cases both, relating to such things as the operation of compressors, chilled water and cooling tower pumps, and cooling tower fans. There are recorders for steam pressure, condenser water pressure, dry and wet bulb temperatures, Btu content of exhibit spaces, chilled water supply and return temperatures, and temperatures of conditioned air being delivered by every air handling unit serving exhibit spaces. There is, in addition, a remote temperature indicating system at every fifth floor of the office building which, in turn, is keyed in to the master panel.

Credits

Guy B. Panero Engineers were mechanical engineers for air conditioning, heating and ventilating, and Almirall & Company, Inc. was the mechanical contractor. Leon & Lionel Levy were architects, with Aymar Embury II, Otto Eggers of Eggers & Higgins, and John D. Peterkin forming a consulting architect and advisory committee. Construction was by Walsh, Fuller & Slattery, a joint venture of Walsh Construction Company, George A. Fuller Company, and Slatter Contracting Company.

Construction cost for the New York Coliseum exhibition hall and the office tower is estimated at approximately $35 million.

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

First Aid Fire Protection

A FIRE standpipe system is required in almost all types of buildings. This system serves not only as the first initial means of combatting a fire by the building occupants but it also serves the fire department. The design of a required fire standpipe system is governed by the regulations of the National Board of Fire Underwriters as well as the local plumbing or fire department. The rules and regulations of the National Board of Fire Underwriters are available in booklet form and are more or less general for the entire nation.

A building owner may desire fire standpipe protection in that type of a building where it is not normally required, or he may request additional fire protection facilities in a building in which the proposed fire standpipe system meets approved minimum rules and regulations. When this type of a request is encountered, the engineer must give consideration to systems designated as "first aid fire protection." Some of the systems used for this purpose are described in this article.

Occupancy Systems

The first type system normally associated with first aid fire protection is that which is installed at the owner's request but which is not required by the national or local fire authorities. A private home is an example of the type of a building in which this system might be placed. Another good example is an apartment house. Many apartment houses do not generally require fire standpipe protection because they are of fireproof construction with metalclad doors and have stairways serving as a means of fire escape exit.

However, although this system is not a compulsory one, certain rules and regulations must necessarily govern its installation. These rules and regulations are necessary to maintain some jurisdiction over the type of systems installed and some control over the proposed use of the water.

Figure 1, shows a typical system that might be installed in a 5-story apartment house.

Assuming that the local authorities do not regard the building as one that must be equipped with a regulation type system, then the system may be classified in the occupancy category. The system illustrated in Fig. 1, has been designed to meet the rules and regulations governing its installation. Therefore, since the building is more than four stories high and exceeds 50 ft in height, the fire standpipe riser must be 2½ inches in diameter. The fire hose is 1½ in. diameter with a ⅜ or ½ in. nozzle.

If the building does not exceed four stories or is less than 50 ft in height, a 2 in. diameter fire standpipe riser could be used. Since the system is classified as an occupancy type, only one approved source of water is needed. If a fire main exists in the street, it may be used for this purpose; otherwise the cold water service in the building may be utilized.

When the fire main is used, a control valve and curb box are generally placed near the curb. A post indicator valve might also be considered for the function. Valves offer a means for shutting off the water supply in the event that the building suffers a severe fire with resulting damage to water lines which could waste considerable water. The water company or local authorities may require that a water flow meter be installed on the fire main in the building to prevent the misuse of the fire line.

If the fire line is to be connected to the cold water main inside the building, it is generally connected as close as possible to the water service entry into the building. Just how this supply line should be connected to the service main and the component piping that must be included, can only be ascertained in each instance by consulting the local plumbing, fire or water departments. When this system is properly installed, it can be counted upon to provide the necessary fire protection sought by the building occupants.

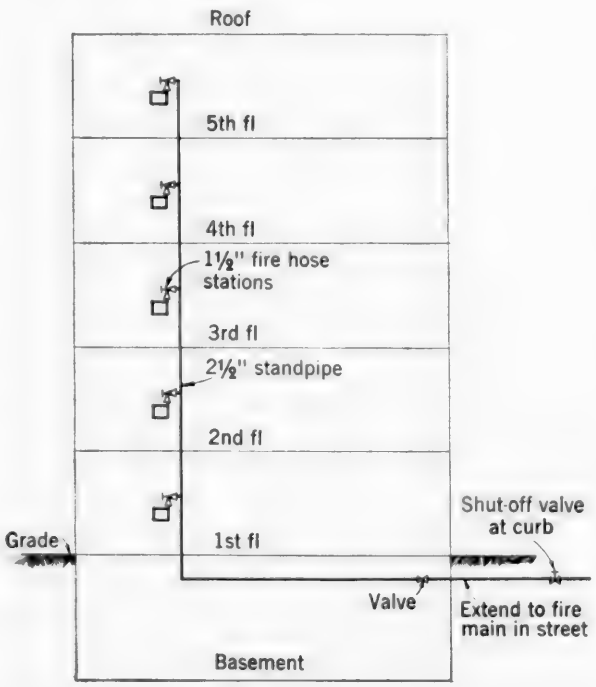


Fig. 1. Typical installation of a fire standpipe system for specific use by building occupants.

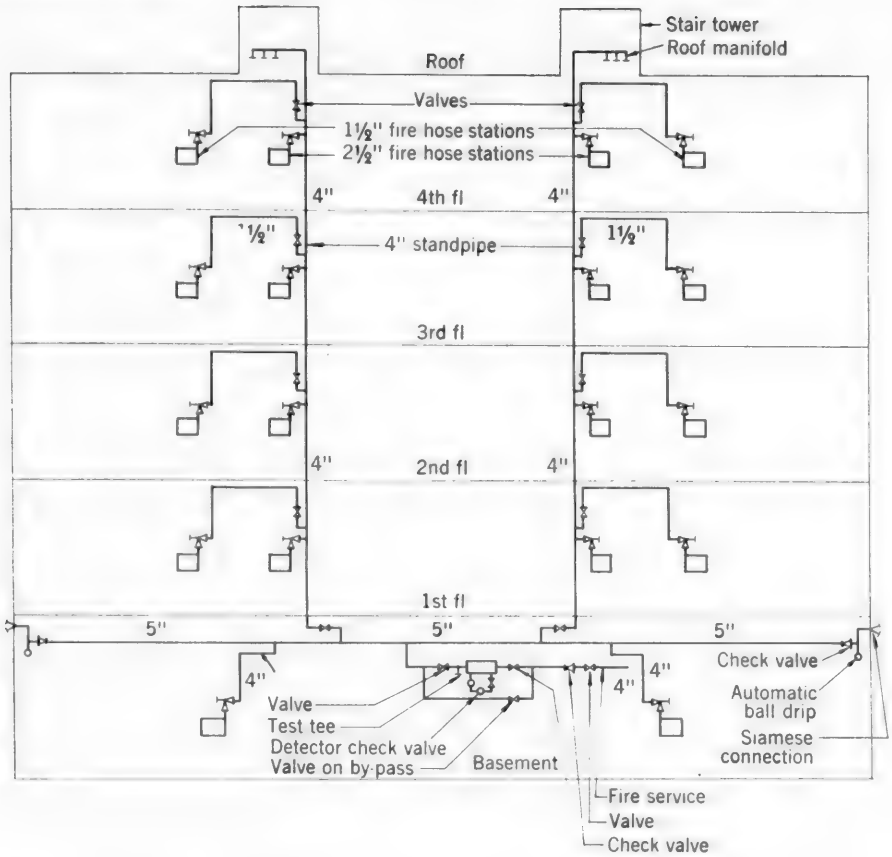
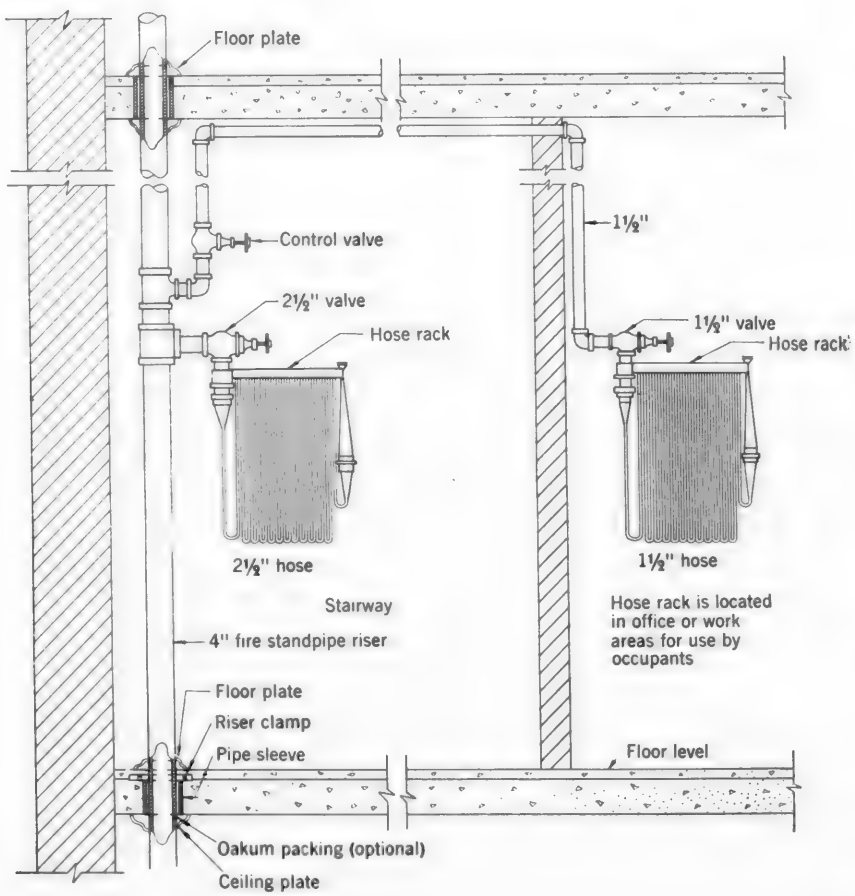


Fig. 2. Arrangement of approved fire standpipe system with extra small stream house station for use by building occupants.

Fig. 3. Arrangement of approved fire hose station and small stream hose station, including valves and piping.



First Aid Fire Protection

An owner or administrator of a building often requests additional facilities to the fire standpipe system that exceeds the minimum requirements of the national and local fire authorities.

Examples are certain types of office buildings, industrial plants, research laboratories, warehouses and other types of buildings where for extra safety, small stream hose stations are placed near the interior office or working space in the proximity of the fire exit to the stairway escape. Such stations normally have an approved fire standpipe system with 2½ in. hose. The additional small stream hose station is for use by occupants in the event of a fire and permits some control of the fire until all the occupants are safely out of the area. Figure 2 represents such a system.

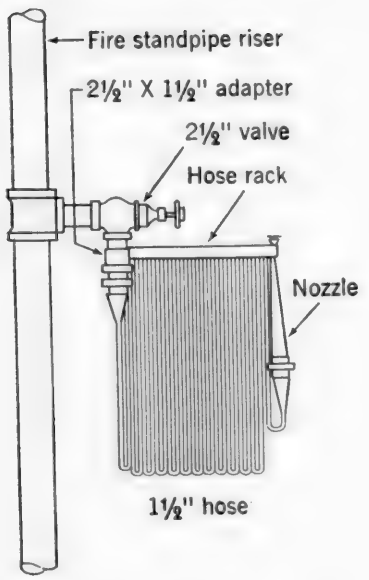
Referring to Fig. 2 note that the basic fire standpipe system is of the approved type that meets the requirements of the national and local authorities. The only modification is the addition of the small stream first aid hose stations in the office or work areas. Figure 3 illustrates in detail, the suggested hook-up for the arrangement of hose racks on a typical floor level. The standpipe riser in this figure is 4 in. diameter; the hose in the stairway is 2½ inch diameter which is the regulation type for use by the fire department. To supply the remote small stream hose stations, a connection is made to the 4 in. standpipe as shown. The 1½ in. gate valve is the means by which the firemen can shut off the water supply to the small stream hose station when the 2½ in. hose station is to be used.

Occupants of a building can usually handle the small diameter fire hose but it takes trained firemen to handle the 2½ in. regulation hose. When full water pressure is turned on in a 2½ in. hose, it can present a serious hazard to the untrained fire-fighters who attempt to handle it. Such a line out of control endangers both life and property. It is for this reason that the smaller hose is recommended.

Illustrated in Fig. 3 is an approved way of furnishing first aid fire protection in a building. In every instance, the national and local authorities should be informed of your proposed design. It is important for the local fire department to have in their files a print of the complete fire protection system installed in the building.

First aid fire protection can be provided in the basement. However, it is general practice to run a 4 in. diameter branch in the basement over to the proposed hose station and then reduce to 2½ in. for the valve and hose connection. The hose would be of the regulation 2½ in. size. The reason why 2½ in. hose is used in this case is because the building maintenance help are usually qualified to handle the larger hose. If desired, 1½ in. hose can be used by fitting a 2½ in. x 1½ in. adapter to the 2½ in. hose valve. Here again, if the hose station is located in a remote area, a valve of the OS&Y type is required on the supply line to the hose station. The valve is generally located in an exit or escape area where it is accessable to the firemen. The valve permits firemen to shut off the water supply to the hazardous area, when necessary.

Fig. 4. Detail of approved hose station equipped with 1½ in. fire hose.



Combination Hose Rack

First aid fire protection is a current consideration in many new buildings now under construction. One way of furnishing first aid protection and yet permit the use of 2½ in. hose is by the method shown in Fig. 4. The standpipe is 4 inches in diameter. Regulation hose of course would be 2½ in. diameter. However, with the speed that fire departments respond to fires today, relatively few minutes elapse between the time a signal is received and the time it takes for the equipment to arrive at the scene.

By installing a 2½ in. x 1½ in. adapter at the 2½ in. valve, it is possible to use 1½ in. hose for the benefit of the building occupants. In the event of a large fire, the firemen can easily disconnect the 1½ in. hose and connect their own 2½ in. hose.

Firemen normally prefer to use their own hose instead of the 2½ in hose that may be on the rack. Since this hose remains unused for a period of time, the fire department prefers to use its own hose of known quality.

Effect of Humidity on Odor

Richard L. Kuehner, research engineer, York Corp., York, Pa., in a paper presented before the ASHAE, gave evidence that normal concentrations of water vapor affect the rate of volatilization of odors from odorous substances, the intensity of odor in enclosed spaces, and the sensitivity of the sense of smell.

Where the odor source is independent of water vapor effect, as in smoking and cooking, a high relative humidity is advantageous. But where the odor is intrinsic, as with linoleum, paint and upholstery, a reduced indoor relative humidity is beneficial. It is conceivable that the standard of 50% relative humidity may not be the most desirable comfort condition from the odor standpoint. The research described was undertaken to explain certain inconsistencies in odor measurement found during the practical evaluation of potential deodorants.

Heating Plant Corrosion

Atoms must strip off their outer electrons before going for a swim, reports our London correspondent in summarizing the papers that were presented at a recent conference held in England on corrosion troubles in heating and ventilating systems.

IN a 200 million Btu per hr high-pressure hot-water heating system the thermostatically-controlled valves began to fail. It was found that the stems and interiors of the valves were coated with cuprous sulphide. The same chemical was found to be coating isolating valves of the pipe system in general. The water was treated with alkali and sodium sulphite and it was difficult to understand where any sulphide could come from. Although the flow temperature was 350 deg and the return temperature 250 deg the temperatures in the pressure and reserve vessels were much lower, and when the pressure vessel was opened it was found to contain a thick layer of sludge. This sludge was rich in sulphate-reducing bacteria and this was the source of the sulphide.

The solution of this problem was to blow down the pressure vessel periodically to remove sludge, an operation which should sterilize it by reason of the high temperature water entering from the main system.

Corrosive Symposium

This was one example of corrosion phenomena reported in a symposium on corrosion which took place at a joint meeting of the Institution of Heating and Ventilating Engineers and the Society for Water Treatment and Examination (*J.I.H.V.E.*, **23**, 453). The latter Society has only recently been formed and is just over three years old. It has a small but expert membership of chemists or biologists engaged in the treatment and examination of water. A joint discussion between these two associations was an excellent proposal and well-justified by the results.

The opening paper was by D. G. Lewis, a member of the Institution, who outlined typical corrosion problems encountered in heating and ventilating practice. Almost all examples of internal corrosion involved a fluid and a metal. The metal is a relatively constant factor and the fluid varies in composition. The question must be faced as to whether improved production techniques have reduced the resistance of common metals to corrosion. Some engineers believe this, and when corrosion occurs there is always the suggestion made that the metal is faulty. On the other hand the apparently greater number of failures that are reported may be due simply to the increased number of installations, and the percentage of failures may actually be less than in former years. There is a case, however, for examining the use of more expensive metals for some purposes, particularly in small plants where control of the fluid composition is impracticable.

One of the puzzling features of corrosion is the outbreaks that occur in certain areas. From the location of failures one would expect that some factor in the local conditions is responsible. Yet by the time a full investigation has been started, the outbreak subsides and the cause may remain undiscovered. To avoid electrolytic action, heating engineers are advised to use the same metals throughout a heating system; yet while iron filings left inside a tank are known to be troublesome, copper-to-iron joints, brass faucets, copper towel-rails plus galvanized hot water pipes, and other mixtures of metals have been used without harmful results. Why?

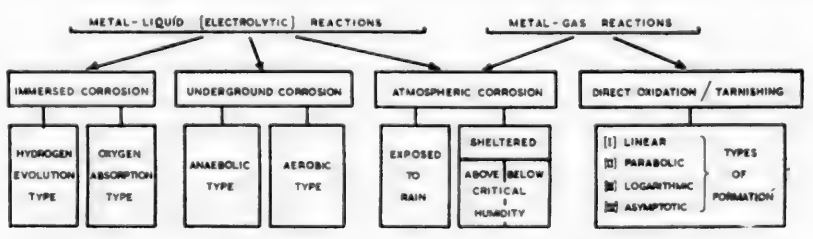
Is it reasonable to use cold water mains for grounding electrical installations if electric currents can be so dangerous? Why do gases, even inflammable gases, continually accumulate in parts of some systems? If this is hydrogen, examples show that electrolytic effects of unlike metals cannot be responsible in every case.

What is the best metal for condensate lines, and why are experiences with condensate corrosion so variable? The lids of aluminum kettles and saucepans do not corrode seriously; can aluminum be used for condensate lines? When may ungalvanized steel tube and malleable iron fittings be safely used for hot water service? What is the best way of hiding pipes in buildings, since so much trouble has been experienced with oxychloride and light-weight porous concrete?

Mr. Lewis mentioned several other topics, such as atmospheric pollution and corrosion of flues and chimneys; and the other three papers were devoted in the main to answering his questions. The authors had had the opportunity of seeing Mr. Lewis's paper in draft, but to some questions there are no answers yet; other points that received insufficient attention beforehand were dealt with in the discussion after presentation of the papers.

Anodes and Cathodes

Drs. F. Wormwell and G. Butler began their paper with a good look at fundamentals. Corrosion processes



Classification of corrosion processes.

may be broadly divided into metal-liquid and metal-gas types, as in the accompanying diagram. When a metal is immersed in a liquid the rate of corrosion is often controlled by the rate of access of dissolved gases to the surface; in atmospheric corrosion the supply of oxygen is ample, and the rate of attack is controlled by access of moisture and trace gases such as oxides of sulphur.

When two metals in contact with each other are also in contact with a liquid which will pass an electric current (e.g. water with salts dissolved in it) corrosion begins. One of the metals will be more reactive than the other, and it becomes an "anode", and tries to dissolve, atom by atom. Supposing it is zinc, then zinc atoms dive in, first taking off their clothes (a couple of electrons). The bank is soon piled high with clothes, i.e. electrons, and is therefore charged with negative electricity. Since the metals are in contact, these electrons leak around through the metal, but the general result is that the metal everywhere becomes negatively charged and exerts an attraction for the positively charged naked metal atoms (called "ions") swimming around in the water. If nothing else happened there would be a continual interchange, some returning to the shore and others going for a swim, like canoes on a public boating lake which are hired out for half-an-hour at a time. However, sometimes they get entangled, as it were, in weeds and form compounds with carbonate ions or with the hydroxyl ions (negatively charged OH) of the water itself. This leaves an excess of positively charged hydrogen ions unpartnered and, feeling lonely, they go to the surface of the less reactive metal, called the "cathode". There some of them get dressed in the electrons which have wandered round, and form molecules of hydrogen gas. This sticks to the surface in minute invisible bubbles and blocks it off from the liquid. This is called "polarization" and when it occurs corrosion does not go on.

But if the hydrogen ions find oxygen at the cathode surface they combine with it, and with the spare electrons, and again form water, and corrosion (solution of the *anode*) goes on merrily. If the temperature is high enough, or the water velocity high enough, the hydrogen gas may not stay at the cathode surface, so corrosion can then occur without oxygen.

Pitting and Scale

If several billion atoms go for a swim, the engineer does not mind provided they come from a very large area. But if they all come from one place, they leave a pit which may develop into a leak. Large anodes and small, easily polarized cathodes are therefore ideal, and the brass faucet or copper towel-rail (cathode) in a galvanized steel system (anode) is trouble-free. But a crack in the mill-scale in a system exposes a little bare metal (anode) and the scale provides a large cathode; corrosion may then be extremely rapid.

Sometimes the ions are brought to grief almost as soon as they dive in. In soft waters ferrous ions form with oxygen and hydroxyl ions a porous rust which is always a short distance away from the anode point and does not prevent further action. But in hard waters this acts as a nucleus for bringing calcium carbonate out of solution and an impervious crust of "chalky rust" may completely seal off the anode and stop further corrosion.

H. S. Campbell in his paper considered particular metals and their various susceptibilities. If the water contains a trace of manganese without at the same time containing some unknown organic substance which inhibits the attack, then copper will eventually be attacked. Manganese dioxide slowly coats the copper surface forming a large cathode; bare copper exposed at pores or breaks in this film is then anodic and pitting occurs. High water temperatures increase this attack. A similar film can be formed on the inside of pipes during manufacture by overheating of lubricant left in the tubes during annealing, forming a carbon film.

Silver and Rubbish

Hot-pressing is convenient method of manufacture of some brass fittings, but the alloy with about 40% zinc must be used, and this (unlike the 70/30 alloy with a little arsenic) sometimes suffers "de-zincification". Many manufacturers are giving up the use of brazing brasses with 40 to 50% of zinc for this reason and are using instead a copper-silver-phosphorous alloy for seams in copper cylinders.

In most hard or moderately hard waters galvanized steel pipes and tanks give good service, becoming protected with a continuous film of scale. *Any* kind of rubbish left on the bottom of a tank interferes with this and will cause corrosion. Iron filings are particularly bad because they cause the zinc nearby to dissolve. In hot water there is chemical action between zinc and water which produces a film on the zinc; then the zinc becomes the *cathode* and any iron exposed at pores or faults in the galvanizing becomes the *anode* and dissolves. This produces pitting. For long life the temperature should not be allowed to rise above 140 deg F for the first twelve months (to form protective scale of calcium carbonate) and should not be held at higher temperatures for long periods even after this initial period.

Copper and Aluminum

Against the general conclusion that a small amount of copper (cathodic) is O.K. in a galvanized steel system, there is the danger that a water that contains *aggressive* CO_2 may attack the copper slightly and then proceed to re-deposit it in spots all over the galvanized coating, which dissolves near the spots, causing pitting. Copper is particularly dangerous to aluminum, and aluminum kettles may suffer badly if filled with hot water drawn from a copper supply system.

Impingement and Condensate

High local water speeds sweep away corrosion products from the neighborhood of anodic areas and supply oxygen to cathodic areas. Since differential aeration and minute differences in structure may lead to differences in reactivity in adjacent areas of the same metal, this gives rise to what is known as "impingement attack". Some alloys resist this better than others, and in particular it has been found recently that an alloy consisting of 5 percent nickel, 1.5 percent iron, rest copper, is very nearly as good as cupronickel or aluminum brass. Such alloys may be useful for condensate lines, and aluminum also would be expected to give good service provided the condensate did not first come into contact with any

(*Concluded on page* 138)

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Cooling Aids Photo Development

PROBLEM: To prepare some 80 negatives, 17 by 17 inches, a mammoth 18-foot mosaic of the Milky Way (the subject of the Special Summer Show, 1957, at Griffith Parks' famed observatory in Los Angeles), it will be necessary to hold temperatures of photographic solutions to within 1 degree of temperature so they can be developed by timing to the same density. This is requisite so that borders between individual plates will not be visible on final mosaic.

SOLUTION: Previous photo work done in the Observatory's photographic lab, often in summer, necessitated use of ice cubes to hold photographic solutions constant. Before this unprecendented job could be undertaken, however, it was decided that temperature control was a necessity. Four types of equipment were considered before management decided upon, and had installed, a ceiling-suspended Spotaire HRC air conditioning unit, manufactured by Drayer-Hanson, Los Angeles. Factors influencing this decision were the fact that the unit required no water for cooling, it used no usable floor space, and required no structural modifications—an impossibility because of 18-inch solid concrete walls. The unit, giving complete heating, cooling and ventilating, is matched with remotely placed G.M. 1½-ton compressor, will use Freon-22; requires no oiling or maintenance.

RESULTS: The Spotaire unit, installed several months ago, has been job tested and double checked to the entire satisfaction of those who will engage in actual preparation of the intricate mosaic. They report actual processing will be undertaken on the gigantic mosaic within an early period.

Air Purification Saves Money

PROBLEM: The Metalphoto Corp., Cleveland, Ohio, recently introduced a process for direct printing of name plates, dials, diagrams, and similar products directly from photo-sensitized aluminum plate. The photographic surface applied to the aluminum is so sensitive that production runs were occasionally spoiled by fogging. It was found that the spoilage was caused by chemical reaction of the surface with sulphide gases which seeped into the plant from the surrounding industrial neighborhood. Spoilage occurred even though contaminating gases were in such low concentration as to be indiscernible to the sense of smell.

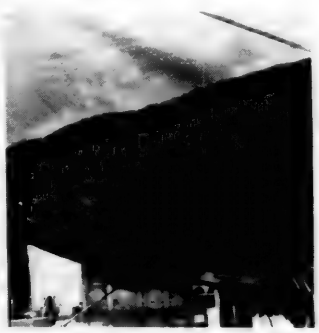
SOLUTION: By introduction of ventilation supply air through activated carbon filters and maintenance of positive air pressure in the section where the plates are made, the trouble was overcome. The activated carbon equipment is a product of Connor Engineering Corp., Danbury, Conn.

RESULTS: There has been no recurrence of the spoilage from outside gases during the year in which the new system has been in operation. The filter system cost less than half as much as the loss resulting from one batch of damaged plates.

48-foot Globe Gets New Overcoat

PROBLEM: Deteriorated insulation on a 48-foot ammonia storage sphere had to be replaced without shutting down the equipment at the Mississippi Chemical Corp. plant in Yazoo City, Miss. Temperature of ammonia inside the sphere had to be maintained continuously at 34 deg F. Trouble developed when the original organic insulation failed. Moisture from condensation had penetrated and migrated through the insulating material, destroying it in less than four years after it had been installed.

SOLUTION: To avoid shutting down equipment, new moisture proof insulation was installed, a small section at a time. The new material, called Foamglas, product of Pittsburgh Corning Corp., is a rigid cellular glass which cannot absorb moisture. It is also fireproof and acid resistant, important considerations in a chemical plant. As the old insulation was removed, a heavy layer of rust was wire-brushed off and steel pins were welded to the surface of the sphere on 9-inch centers. A mastic coating was applied and 2-inch insulation blocks, each 12 by 18 inches, were pressed on over the pins. Another coating of mastic was applied and a second course of insulation blocks impaled on the protruding pins. Joints of the block were staggered and pointed up before a final coating of asphalt was applied. This was followed by a glass fabric membrane and an outside application of weatherproof coating.



RESULTS: Rigidity and light weight of the insulation blocks facilitated their installation. Moisture resistance of the material, demonstrated by rain storms during the application job, is expected to prevent a recurrence of the previous damage.

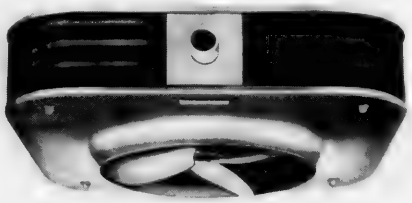
NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on page 85 for securing additional information on new equipment and materials described in this department.

Steam or Water Fed Heaters

Downward or horizontal discharge unit heaters are announced by Warren Webster & Co., Camden, N. J. The unit heaters are being offered in thirty-four models, ranging in capacity from 34,000 to 684,000 Btu per hr (steam ratings).

Named Little Giant. the unit heaters are of the draw-through type and with rectangular, wrap-around, heating elements. Since the elements are designed to operate with either steam or hot water, there is a 50% reduction in the quantity needed for a complete stock supply of the product line. The heating elements are constructed of



copper tubing with extended, corrugated aluminum, plate-type fins. Male pipe connections extend from square steel headers on opposite sides of the vertical discharge unit, permitting installation close to the ceiling and providing maximum headroom. The motor, which has sealed, permanently lubricated bearings or grease-lubricated ball bearings, can be removed through the fan outlet from below, without disturbing the installation.

The heater casings are made of heavy gage furniture steel, with a baked-on, gray-green, hammered finish. The motors are designed for continuous duty and are mounted to eliminate the transmission of noise to the unit casing. A continuous stream of air at room temperature is drawn over the motor during operation of the fan.

Each heater is rated in accordance with the new IUHA Sound Test Code. Air deflector attachments are available in a wide variety to meet unit heater requirements.

More information? Circle Item 1 on postcard, page 85.

Steel Shell Filter-Driers

Refrigerant filter-driers are available with steel shells from Remco, Inc., Zelienople, Pa.

Made for applications in automotive, commercial, and industrial air conditioning and refrigeration, the steel units are painted to prevent corrosion. In all other ways they match copper shell units, combining a Fiberglas depth filter and a molded drying element. The steel filter-driers in both steel and copper have been approved by the Underwriters Laboratories for use with Freon-12 and Freon-22.

The Fiberglas bag in the filter removes foreign matter from the refrigerant stream. The molded drying unit removes moisture chemically, also absorbing acids to a level below possible danger from corrosion.

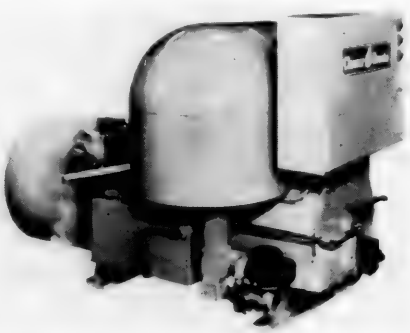
The filter-drier units are available in sizes through 10-tons for Freon-12. Prices for original equipment may be obtained from the company.

More information? Circle Item 2 on postcard, page 85.

Heavy Oil Burner

An air atomizing burner, designed to burn No. 6 oil, is offered by Cleaver-Brooks Co., Milwaukee, Wis. The gun-type burner is called Hev-E-Oil.

Air and oil are metered in the proper ratio at all capacities to assure maximum efficiency. The oil is atomized so that it burns completely. A positive acting metering pump measures the delivery of oil.



The burner does not start at full capacity but begins with a small flame which is gradually built up to the required size. The shape of the flame is adjusted for the type of boiler it is to be used with.

Modern combustion controls are standard equipment of the burner. Motor starting is delayed until the oil at the nozzle is heated.

More information? Circle Item 3 on postcard, page 85.

Refrigerant Sub-Coolers

A line of superheater-heat interchangers has been developed by Heat-X, Inc., Brewster, N. Y., for use on air conditioning and refrigeration systems to insure full utilization of the evaporator surface and eliminate the problem of having part of the surface being used for superheating the refrigerant.

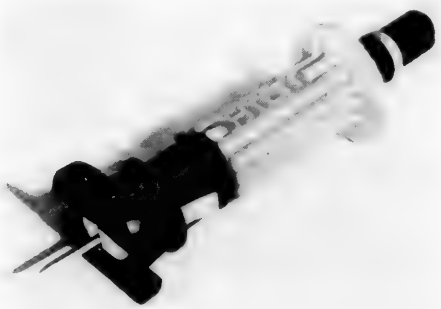
Called SRX, the units combine a superheater with a heat exchanger, featuring the company's patented Inner-fin construction, which provides maximum heat transfer with a minimum pressure drop. The units sub-cool the liquid refrigerant, thereby improving expansion valve operation and increasing the efficiency of the evaporator due to the reduction in the amount of flash gas.

More information? Circle Item 4 on postcard, page 85.

Tool Drives Studs into Steel

A hammer-powered stud driver has been developed by Hilti Rapid Fastening Systems, Inc., New York, N. Y.

With the tool, only three or four hammer strokes are necessary to anchor fasteners into materials such as concrete, brick, cement, masonry, stucco, and steel up to 5/16 in. thick.



A ram in the tool transmits the power from the hammer in the direction of the axis of penetration. A cone seat centers the fastener at its upper end and a base flange or guide jaws hold the fastener at its lower end. A spring inside the tool prevents the ram from rebounding.

A selection of fasteners, both threaded and with round heads, are available from the company in addition to various accessories.

The tool and a 2- to 3-lb hammer, with short handle and square face, can be used to hang water pipes and bathroom and kitchen fixtures.

More information? Circle Item 5 on postcard, page 85.

Heating Time Switch

A time switch that automatically regulates the hours of building heating and divides the day into three heating periods, has been developed by Automatic Devices Co., Inc., Western Springs, Ill.

Called Weather-Chron, the unit contains two switch circuits. The first circuit operates the burner, or valve, with only the safety high-limit controller in the circuit regulating the heating. The starting time of the morning build-up period changes automatically as the outdoor weather changes.

At a pre-selected time, the second switch circuit of the timer connects the daytime heating controller with the circuit to provide regulated heating throughout the day. The heating is stopped, or reduced, at a pre-selected night hour.

An added safety feature automatically eliminates the night setback operation when the outdoor temperature drops below a pre-selected low level, for example, 10 deg F. The time switch then stops all heat to the building when the outdoor temperature rises above a pre-selected minimum, for example, 65 deg.

One-day or seven-day models are available. The seven-day programming model automatically adjusts the hours of heating individually for each day of the week. This permits earlier shutoff times for Saturday and still earlier, or no heat at all, for Sunday, if desired.

All models can come equipped with a clock motor containing a spring, which provides up to 30 hours of operation in case of a power failure.

More information? Circle Item 6 on postcard, page 85.

Plastic Fume Hoods

A lightweight, corrosion resistant fume hood is manufactured by Haveg Industries, Inc., Wilmington, Dela., of polyester glass plastic.

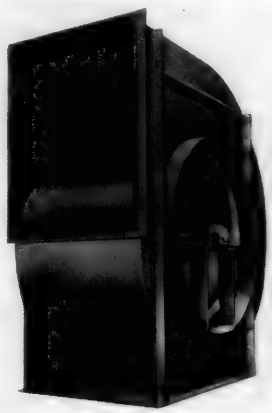
Among the advantages claimed for the material are lightweight, a high impact strength, and resistance to hydrochloric acid and other fumes normally corrosive to other materials. The ease of field fabrication, both for initial construction and possible changes, makes the hoods suitable for industrial fume removal applications.

More information? Circle Item 7 on postcard, page 85.

Line of Centrifugal Fans

A line of centrifugal fans is announced by Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Boston, Mass.

Designated Series 6000 Silentvane, the fans make possible 92% peak mechanical efficiency and 88% static efficiency in the movement of air in high pressure air conditioning, industrial process ventilation, and vehicular



tunnel ventilation. The Airfoil type blading is responsible for the high efficiencies and lower noise energy.

Each fan in the series attains its maximum horsepower within the normal range of fan selection. The fans are designed for direct connection to conventional squirrel cage induction motors operated at standard motor speeds.

For those applications requiring regulation of air output over a wide range of operating conditions, inlet vane control is available, operated either manually or automatically.

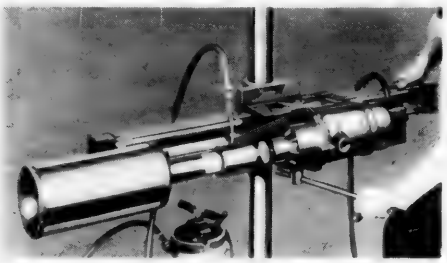
Sixteen fan models are offered with wheel diameters ranging from 27 to 108 in.

More information? Circle Item 8 on postcard, page 85.

Diamond Drilling Machine

A portable drilling machine has been redesigned to accommodate diamond bits up to 14 in. by Wheel Trueing Tool Co., Detroit, Mich.

Engineered for adaptability in size of motors and drill bits, the new machine can drill in any position, having a 360-degree arc of swing, and can be raised and lowered on the pillar for level horizontal drilling at any height.



With standard Truco swivel diamond bits, any size hole up to 14 in. can be drilled by the unit in concrete, tile, granite, marble, brick, and other hard, brittle materials. Test units averaged approximately one inch per minute in drilling reinforced concrete.

Weighing 200 lb. the unit can be dismantled and carried in parts by one man. The base has four leveling screws to stabilize the machine and maintain grade in drilling on an uneven floor. For drilling in cramped quarters, it can be mounted on a 6-in. square base and locked in position against the floor and ceiling or from wall to wall.

Three heavy-duty motors for mounting on the drilling machine provide power for varying drilling conditions, bit diameters, and depth of hole. The motors operate on a-c or d-c current with 110v, 60 cycles or less.

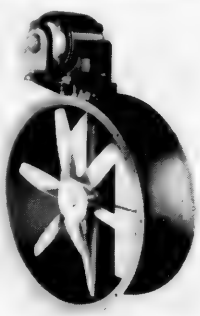
A selection of shaft adapters will fit swivels to drill motors with chucks of varying size.

More information? Circle Item 9 on postcard, page 85.

Duct Exhaust Fan

A duct fan for paint spraying booths, industrial ventilation, and exhaust is placed on the market by The Peerless Electric Co., Fan and Blower Div., Warren, Ohio.

The new unit is a belt-driven tubeaxial fan suitable for numerous industrial applications. It is made in diameters for standard duct sizes, and various selections of horsepower for each size allow a range of air capacities.



Both the V-belt drive and motor are isolated from the air stream so that there is no contamination to the motor or belt from vapors carried in the duct work. Both fan and motor are fitted with ball bearings so that they may be mounted in any position. Fan blades are non-sparking, heavy cast aluminum and are suitable for handling explosive gases.

The steel housing of the duct fan is completely arc-welded together to provide an airtight fit. Heavy angle iron rings on each end of the housing are punched for mounting. An airtight cylinder through the center of the fan protects the belt and bearings from the air stream. The motor base is made of heavy steel with an easy belt adjustment feature. The entire unit except the fan blade is painted gray enamel.

Motors are open drip-proof, ball-bearing motors for 1750 rpm. Totally enclosed or explosion-proof motors can be furnished if desired. Single-phase motors are capacitor-induction types, and three-phase motors are induction type.

More information? Circle Item 10 on postcard, page 85.

Glass-Lined Storage Tank

Production on an 80-gal. glass-lined hot water storage tank has been started by Permaglas Div., A. O. Smith Corp., Kankakee, Ill. The tank is the smallest unit in the company's line of glass-lined storage tanks.

The new unit measures about 64 x 20 in. and weighs 240 lb.

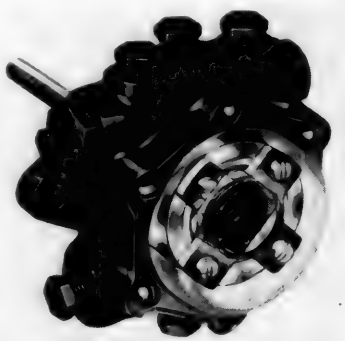
The tank will cost little more than ferrous tanks of the same volume. It will find its commercial applications in restaurants, small apartment buildings, and in industrial uses. Installation can be either vertical or horizontal.

More information? Circle Item 11 on postcard, page 85.

Fuel-Unit Has Rotary Filter

An oil burner fuel-unit, named Service Saver, that is equipped with a rotary filter instead of the conventional strainer has been developed by Webster Electric Co., Racine, Wis.

The rotary filter is self-cleaning and eliminates the need for wire mesh strainers and felt or paper filters. It has



a particle discrimination of 125 microns, which is equal to the seining efficiency of a 100-mesh screen.

A sump is provided in the cover of the fuel-unit's pump to collect any foreign matter rejected by the filter.

Designed to replace fuel-units now in use without piping changes, the unit has optional inlet and return line ports and can be rotated 360 degrees for mounting. It is available both as a single stage and as a true two-stage unit. The single-stage pump is identified by a red cap, the two-stage pump by a metallic gold cap. Either the single stage or the two-stage will work mounted in any position.

More information? Circle Item 12 on postcard, page 85.

Fan Coil Room Air Conditioner

A fan coil, room air conditioning unit is added to the line of heating and cooling equipment made by Mueller Climatrol, Milwaukee, Wis.

Designed for hotels, hospitals, motels, offices, and other multi-unit buildings, the air conditioner is for use with a centrally located hot or chilled water source. One unit is located in each room and contains a four-row coil for both heating and cooling plus twin centrifugal circulating fans. The units also provide individual room control, fresh air circulation when desired, and filtration of both outside and room air.

Two styles of the room conditioner are available. The Model 60 is a recessed type with open ends for installation in an alcove, wall, or with cabinet bases. The Model 61 (illustrated) is completely enclosed in a casing, with a beige baked-on enamel finish, for installation flush against a wall or under a window. Both coil units are supplied in fan capacities of 200, 300, 400, or 600 cfm.

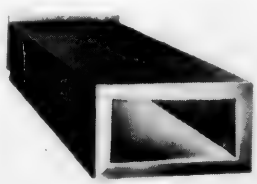
Other features of the unit are: a four-row coil with low pressure drop; dual low speed, aluminum blowers; three-position fan speed switch adjustable to occupant's desires; permanent, cleanable filters, accessible from front; and the entire cabinet slips off chassis for installation and service. The fan coil units may be installed either in existing or new buildings, room by room, with three pipe connections: water supply, return, and condensate drain.

More information? Circle Item 13 on postcard, page 85.

Dust Collector Silencers

An exhaust silencer, intended for use where quiet operation is desired of cabinet-type dust collectors, is a new product of Torit Mfg. Co., St. Paul, Minn.

The silencer is available in five models to fit the exhaust openings on the company's 50, 60, 70 and 80 series and the Model 122 collectors. Although the dust collectors are designed to run quietly, some applications require even greater noise suppression for plant employees' comfort and operating efficiency.



The three small silencers are made of 20-gage steel and extend 30 in. above the top of the collector to further reduce the noise effect; two larger models are built of 16-gage steel and extend 36 in. All five are rectangular in cross-section and are interlined with 1 in. of closed, cellular vinyl foam.

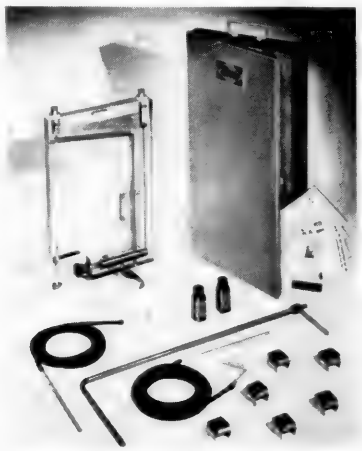
All the silencers are given a baked-on, wrinkle finish to match the collector cabinets. They can be attached to new units at the factory or to collectors now in use.

More information? Circle Item 14 on postcard, page 85.

Air Velocity and Pressure Gage

One gage that measures both air velocity in feet per minute and static pressure in inches of water is available from F. W. Dwyer Mfg. Co., Michigan City, Ind.

Designed for heating, ventilating, and air conditioning servicemen, the portable unit permits professional testing



and adjustment of newly installed or repaired systems. Readings of the gage are direct and require no reference to graphs or tables. Two capacities cover the common range of pressures. Model 400-5: 0 to 5 inches of water; 400 to 9000 fpm; and Model 400-10: 0 to 10 inches of water, 400 to 12,600 fpm.

Made of transparent plastic, the air velocity meter has no moving parts or delicate vanes to get out of adjustment. The gage comes in a 10¼ x 20¼ x 1½-in. steel carrying case that is fitted for all accessories. The latter include an 18-in. stainless steel calibrated pitot tube; rubber tubing with connectors; Magneclips for mounting to metal surfaces; additional gage oil; and plastic laminated instruction and data cards.

More information? Circle Item 15 on postcard, page 85.

Packaged Duct Fittings

Pipe duct fittings are being packaged in corrugated cartons by Adelta Mfg. Co., Inc., Philadelphia, Pa., to make it easier and more economical for jobbers and heating and air conditioning contractors to ship, store, protect, and handle elbows and angles.

The packaging of the fittings now puts the company's complete line of standardized pipe, duct, and fittings in unit cartons so that jobbers do not have to count and carry loose material or build special bins. The cartons are marked so that their contents can be quickly and easily identified.

More information? Circle Item 16 on postcard, page 85.

Cooling Control Panel

An electronic air conditioning selector panel has been developed for offices, small department stores, drug stores, or supermarkets by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Designed for flush mounting on a wall within arm's reach of the manager's desk, the Plexiglass panel contains dials that give control over the temperature in the store; permit raising or lowering of the amount of outdoor air for ventilation; and provide for manual or automatic fan operation or shutoff. The panel is lettered in a reverse-engraved process.

While providing for remote adjustment of temperature, outdoor air, and fan operation to meet changing indoor and outdoor conditions, the panel does not affect such automatic features of electronic air conditioning control as outdoor temperature compensation and automatic switching from heating to cooling.

The control panel may also be provided in a locked box to prevent tampering. Both types are described in a leaflet available from company branch offices or from the firm's commercial division.

More information? Circle Item 17 on postcard, page 85.

Low Temperature Insulator

A license to manufacture and market Uni-Crest, an expanded and expandable polystyrene for low temperature insulation, has been acquired by United Cork Companies, Kearny, N. J. Original patents for the manufacture of the material are the property of Badische Anilin & Soda-Fabrik A.G., Ludwigshafen, West Germany.

The license permits the company to utilize the processes and techniques developed by European chemists during the post war years. These processes and techniques permit the molding of the polystyrene beads into any shape or form desired with a controllable density. The flexibility of the material in thin sections makes possible installation around curved surfaces.

The insulating material is available in molded slab, brick, or block form in lengths up to 12 ft, widths up to 4 ft, and thicknesses up to 8 in. It can also be molded to specification in any number of shapes, sizes, and densities.

The finished product is made from beads resembling very coarse grains of sugar. When expanded and welded together they form an homogeneous white product composed of minute individually closed cellules, ranging in density from 1 to 20 lb per cu ft. It can be produced at any specified density within the range cited and can be cut with a knife, electrically heated wire, or ordinary sawing equipment.

More information? Circle Item 18 on postcard, page 85.

Furnace Vacuum Cleaner

A new model, No. 520, vacuum cleaner for furnace cleaning operations is announced by American Cleaning Equipment Corp., Chicago, Ill.

The vacuum cleaner is offered with a complement of standard attachments that include a 10-ft x 1½-in. hose, an 18-in. service tool, and an Orlon insert bag.

Equipped with a universal 1⅓-hp motor, the unit has a static lift of 66 in. of water. The air displacement at the 1½-in. opening is 210 cfm. The tank size is 12 gal, and the unit is 26 in. high, 18 in. wide, and weighs 37 lb.

More information? Circle Item 19 on postcard, page 85.

Pipe Bender

A remote control pipe bender that weighs 68 lb is manufactured by Tal Bender, Inc., Milwaukee, Wis.

Available in two models, the unit is equipped with bending shoes for 1- to 2-in. pipe (Model No. RC 200/C) or 1½- to 2-in. pipe (Model No. RC 200/PH). It will

make any degree bend in one setting in pipe or rigid conduit and bus bar. It can also be had to bend EMT or copper tubing and, if used with the standard all purpose frame, with a pipe straightener.

The bending frame has a removable top plate which permits laying the pipe in from the top, sliding the pipe in from the side, or hooking the bender over an installed pipe.

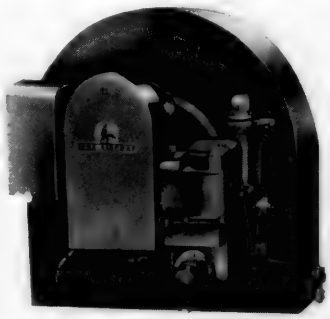
The unit can also be obtained with an electric motor pump.

More information? Circle Item 20 on postcard, page 85.

Rotary Oil Burners

A series of rotary oil burners, all with integral air registers, is announced by Iron Fireman Mfg. Co., Cleveland, Ohio.

Ranging in size from 9 to 125 gph, the burners will fire with No. 6 or lighter oil and are designed for either natural or induced draft with approximately 0.10 to 0.15 inches of water required for full rating.



The integral air register assures maximum combustion efficiency over the burner's firing range. Combustion air is introduced through the firing port in order to facilitate the mixing of oil and air and to cut excess air to a minimum.

No checker floor for introducing secondary air is needed, since it is introduced through the integrally mounted air register.

The burner is shipped in two sections: the burner proper, and the air register. The two units may be bolted together on the job.

A modulating type automatic actuator provides the correct amount of fuel and air to maintain the desired water temperature or steam pressure. Primary combustion air is supplied by the burner fan; secondary air is introduced through the air register.

Electronic safety controls automatically shut off the burner if an unsafe condition arises. A programming control sets up the proper sequence of operations in stopping and starting the burner. A sensitive limit control operates the burner to hold the temperature or boiler pressure at the necessary level.

More information? Circle Item 21 on postcard, page 85.

Air Filter Is Improved

An improved version of the Pliotron electrostatic air cleaner for heating, ventilating and air conditioning systems is placed on the market by Industrial Products Div., Goodyear Tire & Rubber Co., Akron, Ohio.

Considered a heavy duty model, the air cleaner is constructed in three sections, each consisting of electrostatic plastic materials. The intake side is a screen of vinylidene chloride and the outlet side is made of a plastic bonded, glass fiber mat. Sandwiched between the outer layers is shredded polyethylene film, the material used in the standard models.

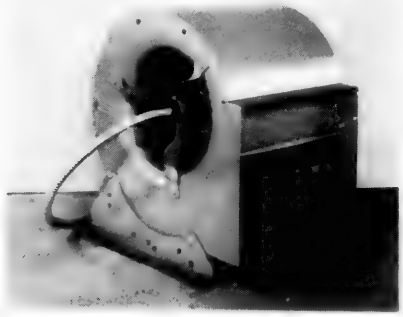
The improved air cleaner was developed to overcome problems in applications where dust concentration is unusually high, where large particles such as chaff, straw, and insects impinge on filter surfaces and where effective, single-pass filtration is required.

Electrostatic filters hold atmospheric dust and other types of airborne particles magnetically. They can be cleaned by immersing them in warm water. The static charge runs off in the water, thus releasing the captured materials.

More information? Circle Item 22 on postcard, page 85.

Blower Has Integral Motor

A blower with a motor that is integral with the blower wheel is announced by Morrison Products, Inc., Cleveland, Ohio. The rotor, to which the blower wheel is



assembled, rotates around the fixed shaft and field assembly. This central location of the motor in the wheel allows a more uniform air distribution.

Made for 4-way discharge positions, the blowers, called Intra-Drive, are available with capacities from 500 to 1500 cfm at static pressures from 5 to 1.25 inches of water. The units can be applied in either a horizontal or vertical plane and are equipped with a BX cable connection.

The permanent split capacitor motor has an integral overload protector and is available with a speed controller.

More information? Circle Item 23 on postcard, page 85.

Flame Cutoff Machine

A flame cutting machine is being made by Speedi-Burn Products Co., Inc., West Hempstead, N. Y., for straight cutoff and beveling operations on medium and heavy industrial piping.

For pipe cutoff operations, the oxygen torch is mounted radially and in operation describes a complete revolution about the work. Built-in, safety limit switches stop the rotation of the torch head at the completion of the cut.

Pressure piping may be beveled with machine accuracy and uniformity on the cutoff machine. To perform this operation, the torch is mounted in an adjustable angle clamp and set to the desired bevel angle.

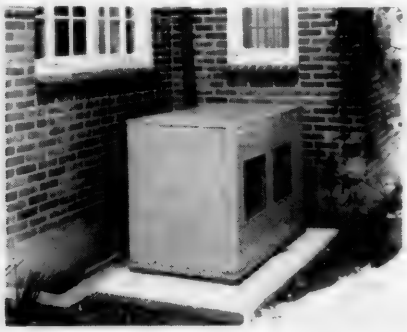
To accommodate the full range of pipe wall thicknesses and diameters, the torch head is driven through a variable speed drive mechanism.

A companion model to the unit shown is provided with a hollow spindle. Capacities are available to handle up to 24-in. diameter pipe.

More information? Circle Item 24 on postcard, page 85.

Air-Cooled Equipment

A line of air-cooled equipment for residential and commercial air conditioning and refrigeration applications, and new residential cooling coil units are introduced by Frigidaire Div., General Motors Corp., Dayton, Ohio.



The air-cooled condensers (illustrated) are offered in 2, 3, and 5-ton capacity sizes. They are for use in conjunction with self-contained air conditioning equipment or commercial refrigeration products where it is desirable to provide air cooled operation.

Complete air-cooled condensing units are also available in sizes of 2, 3, and 5 tons. These are basically the same as the condensers except for the addition of a compressor. They are designed for outside installation with a steel weatherproof housing and offer operational advantages where water restrictions or high water rates are encountered.

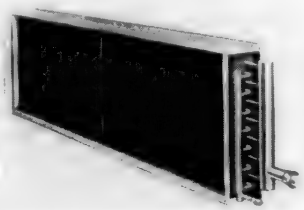
The residential cooling coils for both vertical (upflow or downflow) and horizontal air flow are available in 2, 3, and 5-ton capacity sizes. These units are for use with conventional heating systems to provide year-round air conditioning when combined with the new condensing units.

More information? Circle Item 25 on postcard, page 85.

Line of Steam Coils

An improved line of Recold steam coils is offered by Refrigeration Engineering, Inc., Los Angeles, Calif. Included are standard steam coils, heavy duty coils, low capacity coils, and non-freezing coils.

A feature of the coils is their design, which provides equalized temperature throughout the coil when steam is throttled. This is important because steam coils are selected for maximum conditions but consistently operate at reduced capacity. Stratification occurring in conventional coils when steam is throttled produces overheated air at one end of the coil and underheated air at the other end.



On steam coils with operating pressures over 30 psi, the company recommends the heavy duty coil. This coil has tubes with thicker walls and utilizes a brazing material which enables the coil to withstand high pressure steam. The series is available for both standard and non-freeze coils.

For applications, such as tempering and reheating, where low capacity is required, the company offers the low capacity coil. This coil has four fins per inch and 60% of the capacity of standard coils. It is also available for both standard and non-freeze coils.

In non-freeze coils the inner tube is placed into the normal tube of the steam coil. Vent spacings are varied to compensate for pressure losses along the tube and to equalize steam distribution through the entire coil.

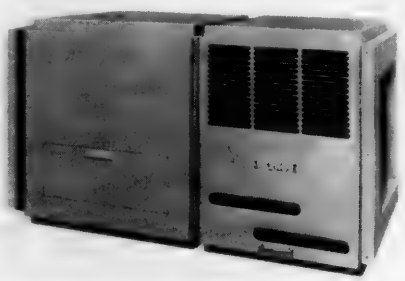
Steam, forced into the inner tube, makes a complete pass through the coil. The vents permit steam to pass into the outer tube as condensate is formed. As condensate drains, it is continually warmed by the contact with the inner tube. This prevents freezing of condensate within the coil.

More information? Circle Item 26 on postcard, page 85.

Redesigned Horizontal Furnace

A redesigned line of PAC gas-fired, horizontal furnaces is being produced by Reznor Mfg. Co., Mercer, Pa.

Interchangeable panels are being put on the blower compartment to make it as easy to bring the return air duct in at top, bottom, or either side as at the conventional end opening.



Because airflow through the heater may be in either direction, it can always be installed with the access door to controls and burners on the most convenient side. The unit is shipped assembled for the direction of airflow specified on the order, but can be converted in the field for airflow in the opposite direction if plans are changed.

The 75,000 Btu per hr model measures 22¾ x 22¾ x 37½ in. The side panels are 20 in. high; the same height as the connecting ducts.

On the new model, filters and filter racks are optional equipment. Racks can be added as needed between the return air opening on the blower housing and the return air duct. Filters can be changed from outside the cabinet with no doors to open or access plates to remove.

A fourth size, 50,000 Btu per hr, has been added to the series which formerly included only 75,000, 100,000 and 125,000 Btu per hr models.

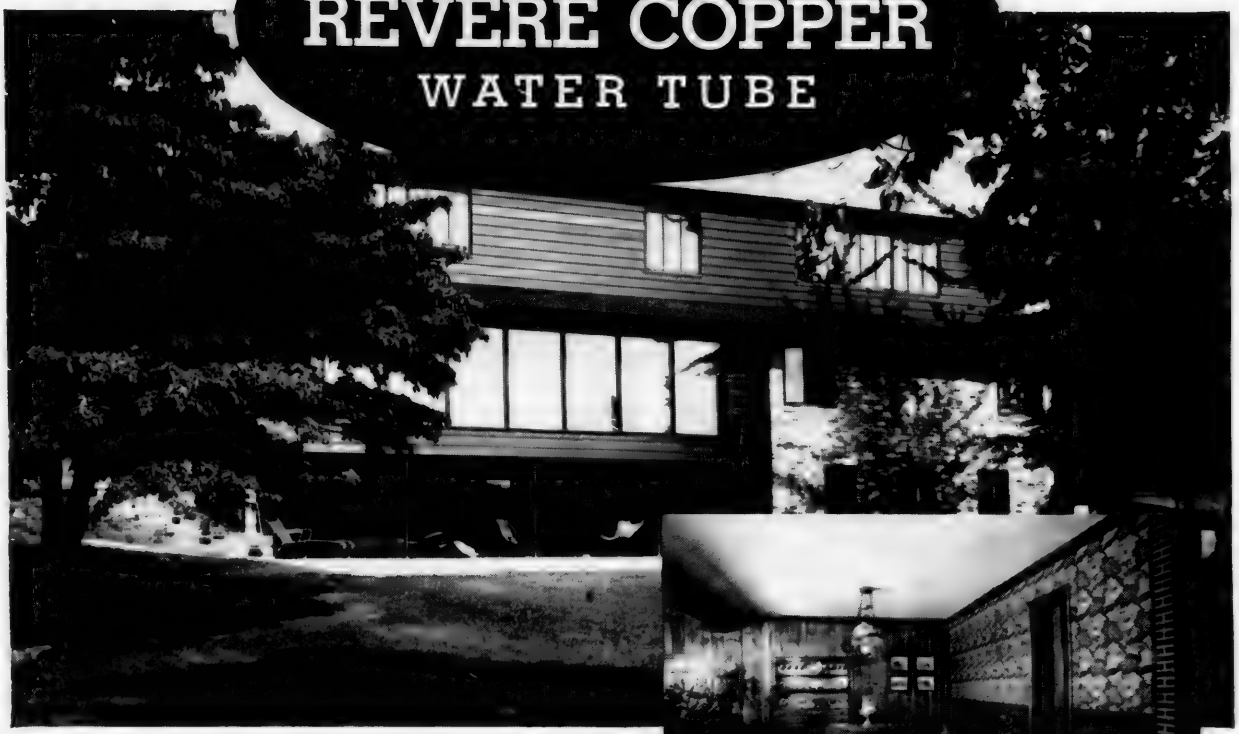
The unit is approved by the AGA for use wherever a horizontal furnace is acceptable.

More information? Circle Item 27 on postcard, page 85.

(*Continued on page* 106)

what they're doing with

REVERE COPPER WATER TUBE



1,740 feet used for hot water heating and air conditioning lines in residence of Charles L. Humphries, Paducah, Kentucky

Architectural Engineer: G. ANTHONY JOHNSTON, Paducah
Builder: LESLIE FEAST, Paducah

An interesting feature of this residence is the combined winter heating and summer air conditioning system which has a boiler for winter use and a water chiller for summer use, with a transfer valve that diverts the water from one to the other as needed. Water is circulated through units that are in the rooms while fans blow air over the tubes in the units.

Said the Architectural Engineer, "I specified Revere Copper Water Tube for both of these systems because I knew the enduring and non-rusting qualities of copper would result in a satisfactory installation for my client." Said the Builder, "Using Revere Copper Water Tube upheld my reputation as a builder of quality homes and at the same time cost no more than rustable pipe." Said the Contractor, "I'm glad Revere Copper Water Tube was used for it's easy to work and handle and makes for a nice clean job."

Be smart! Play it safe with an all-copper installation. Use Revere Copper Water Tube for hot and cold water lines, air conditioning lines, radiant panel heating, underground service lines, drainage, waste and vent lines.

For more information on Revere building products send for 28-Page Booklet—"Building to Endure with Revere". It's free!

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER * BRASS * 1801 * REVERE * ALUMINUM

AT LOWER RIGHT in above photograph is one of the units which are used throughout the house. Revere Copper Water Tube carries hot water to the units in winter and cool water in the summer. Fans in the cabinets then circulate the hot or cool air, as the case may be, throughout the rooms.

No wrench-room worries here. Easy-to-solder Revere Copper Water Tube can be fitted into the tightest corner. Vertical lines shown come from the water chiller. G&H PLUMBING & HEATING COMPANY, Paducah, was the Contractor who installed the 1,740' of non-rusting Revere Copper Water Tube in sizes from ⅜" to 2". Tube was furnished by the HOE SUPPLY COMPANY, Paducah, Revere Distributor.

(*Continued from page* 104)

Centrifugal Blower Wheel

A Class II centrifugal blower wheel for commercial and industrial heating, air conditioning, and ventilating systems is available from The Bishop & Babcock Mfg. Co., Massachusetts Blower Div., Cleveland, Ohio.

Suitable for medium and high velocity air conditioning systems, the backwardly inclined wheel is offered in a range of diameters from 21 to 86½ in., both single inlet, single width and double inlet, double width. The wheel is made from die-formed, cast, and spun parts which are welded or riveted, or both, into the final assembly.

With a maximum tip speed of 13,000 fpm, the wheel (special steel) has been operated through a temperature range from −80 to 550 deg F.

More information? Circle Item 28 on postcard, page 85.

Machine Can Cut 12-in. Pipe

The Standard No. 20 abrasive cutting machine manufactured by Beaver Pipe Tools, Inc., Warren, Ohio, is also made in what is called the Hi-Boy. This model cuts pipe up to 12 in. by raising the entire cutting head, including motor mount, motor, and wheel guard, with a solid lift block.

A longer vise chain is furnished to accommodate the larger material. In cutting larger sizes, from 6- to 12-in. pipe, a 14-in. wheel is used, and the pipe is turned.

Small sizes of material may be ganged for a greater saving of time. As in all the company's machines, a 20-in. wheel is used for cutting small sized material. As the large wheels wear down, they are used to cut 6-in. and larger sizes. This gives the user a maximum economy in cutting wheel use.

The Hi-Boy model cuts up to 12-in. pipe; 6-in. shapes; and 2½-in. solid stock. The wheel speed is 2400 rpm with a 1-in. arbor; the net weight is 560 lb, shipping weight 700 lb; and the height including the base is 66 in., width is 20 in., and length 40 in. It can be furnished with either a 7½- or 10-hp 220/440-v, three phase, 60-cycle motor.

More information? Circle Item 29 on postcard, page 85.

Glass Fiber Filter Media

A non-combustible, glass fiber, filter media is being produced by Mine Safety Appliances Co., Pittsburgh, Pa., for its Ultra-Aire space filter. The filter is used in hospitals and research laboratories and in nuclear energy, photographic, food processing, pharmaceutical, optical, instrument, and other product control and processing industries where exceptionally clean air is required. It also provides clean air to personnel working in hazardous or annoying atmospheres.

The effectiveness of the glass fiber web is rated for a penetration of less than 0.03% by particles 0.3 microns in diameter. It can filter cigaret smoke with a content of particles from 0.05 to 0.10 microns.

More information? Circle Item 30 on postcard, page 85.

Air Conditioner for Schools

A year-round air conditioner has been designed by American Air Filter Co., Louisville, Ky., for schoolrooms throughout the northern and central parts of the country.

Called the HerNel-Cool, the school air conditioner was developed to fill demands resulting directly from in-

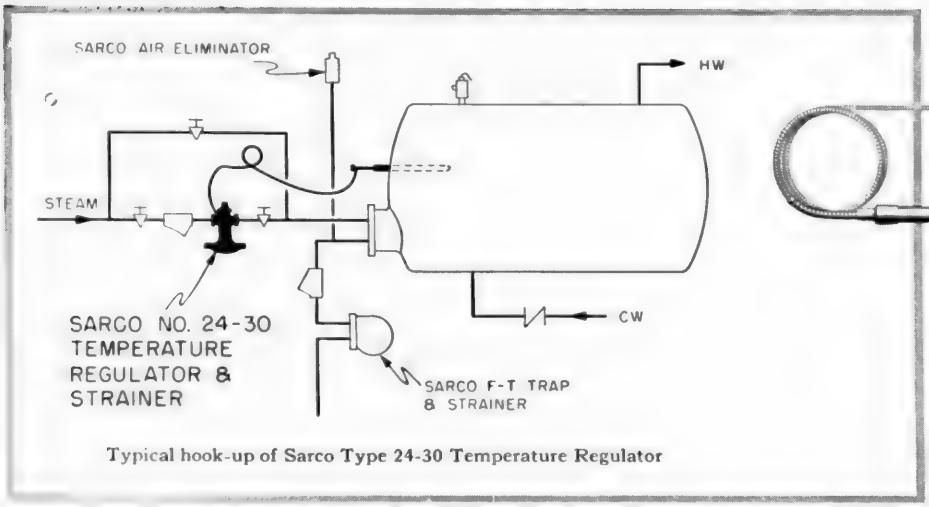
creased school enrollments and the rapid growth of eleven-month, four-quarter, and summer school programs in both high schools and universities.

The cooling unit operates like traditional classroom unit ventilators during winter, early spring, and late fall months—blending outdoor air with recirculated room air to heat, ventilate, cool, and eliminate odors. When outdoor temperatures rise above the desired classroom comfort level, chilled water is introduced into the unit, and the proportion of outside air is reduced.

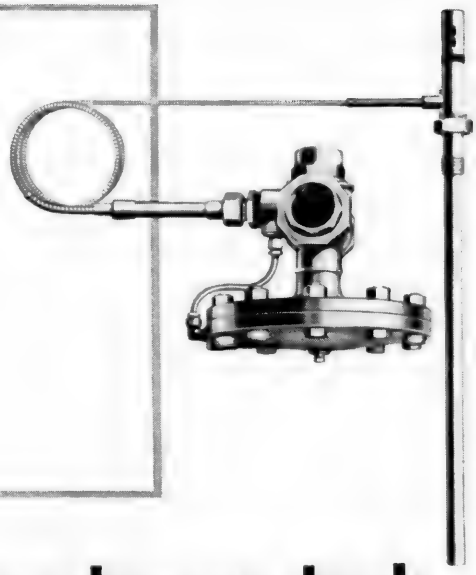
Because of its design, the unit can introduce up to 100% of the desired ventilating air from outdoors. This permits pre-cooling classrooms with night air, as well as using outdoor air, without refrigeration, to offset the heat caused by the sun, electric lighting, and active children on temperate days.

More information? Circle Item 31 on postcard, page 85.

(*Continued on page* 108)



Typical hook-up of Sarco Type 24-30 Temperature Regulator



HOT WATER...in your storage tank

...<u>when</u> you want it...*and at minimum cost!*

That's the performance you get when this Sarco Temperature Regulator stands guard on your water heater.

With fuel representing about 50% of your total direct power costs, it's important that you *get hot water at lowest cost per wash.*

Here's how the Sarco 24-30 Temperature Regulator does the job:

NO OVERHEATING – during periods of no draw-off. The single seated valve shuts tight, prevents creeping of temperature.

LOW INSTALLATION COST – the T R 24-30 is self-contained and self-operated, no need to install compressed air or electric lines.

CLOSE TEMPERATURE CONTROL – thermostat actuates internal pilot valve which immediately opens or closes main valve.

LOW-MAINTENANCE PACKLESS SEALS – trouble-free design eliminates stuffing boxes, no repacking, no sticking or leakage of exposed valve stems.

WIDE RANGE OF ADJUSTMENT—you can adjust this temperature regulator 25° higher or lower than the temperature setting.

So, if you're not satisfied with your hot water service, call your local Sarco representative or write for Bulletin 600. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

Need Tempered Water ?

This Sarco Water Blender automatically mixes hot and cold water, delivers blended water at any desired temperature. Factory set for any temperature to 200° F., is easily adjusted to 15° F. lower and up to 40° F. higher than factory setting. Ask for Bulletin 800.

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SAVES STEAM

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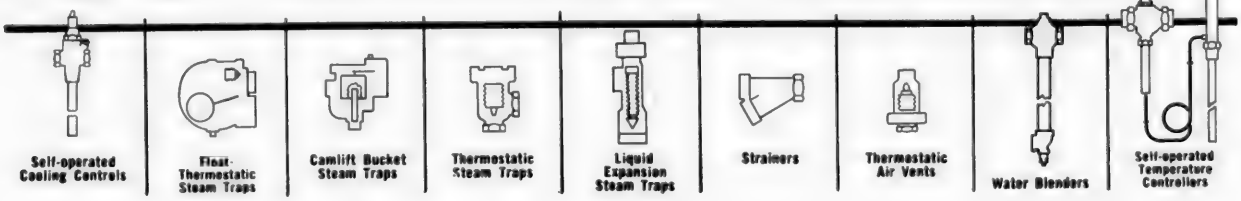
STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES



(*Continued from page* 106)

Seven-Day Time Switch

A seven-day time switch is incorporated into its standard line by Tork Clock Co., Inc., Mt. Vernon, N. Y.

Called the 7D1191, the switch has a slow moving dial that is divided into seven sections, marked for each day of the week.

Requiring a full week to make one complete revolution, the dial will accept screw-on trippers at even two-hour periods in each of its daily segments. The use of the screw-on trippers for *on-off* action also permits manual operation of the time switch, if desired, without the need for relays, as in former models.

The switch is recommended by the company for use wherever daily schedules in lighting, heating, ventilating, air conditioning, refrigeration, or display signs may require variance. This would include office and industrial buildings, retail stores, and institutions.

Use of the switch makes possible the starting and stopping of a given operation at different times each day, as well as to eliminate all operations on Sundays or weekends. (Where only weekend or daily omission is required and the daily *on-off* schedule is constant, the company recommends its Skip-A-Day dial rather than the 7-Day.) The screw-on trippers also make possible the alteration of schedules should the program vary from week to week.

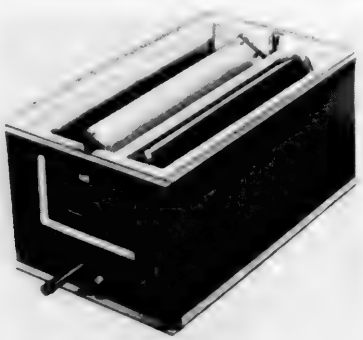
Distributed through electrical wholesalers, the switch is also available in double-pole and other models. Bulletin No. 155 lists all Seven-day and other standard light and power time switches, their uses, and housings.

More information? Circle Item 32 on postcard, page 85.

Central Air Conditioners

A residential cooling coil and remote condenser are offered by McQuay, Inc., Minneapolis, Minn., for waterless, central station air conditioning in new and existing homes.

Designed for use with forced air furnaces, the components (plus a compressor) combine with existing duct-



work to provide cool, de-humidified air to every room in the house. For homes equipped with gravity feed furnaces, the equipment can be adapted with the addition of a blower fan and filters.

The cooling coils (illustrated) are available in 2, 3, and 5-ton sizes for Freon 12 or Freon 22 refrigerants. Horizontal air flow evaporators are made for insertion in duct-work on either the return or discharge side of the furnace. The vertical airflow model installs in the plenum of a conventional or counterflow furnace. Both models are designed for internal mounting of the expansion valve.

Named Aircon, the air-cooled condensers are designed for remote installation in a garage, attic, or backyard.

Three sizes match the 2, 3, and 5-hp Freon 12 or Freon 22 compressors. The condensers have thermally protected motors and low speed centrifugal fans. Space is provided in the cabinet for mounting the compressor and receiver.

More information? Circle Item 33 on postcard, page 85.

Filter Needs No Power Supply

An oil bath air filter designated LPD is announced by Air-Maze Corp., Cleveland, Ohio.

Operating without an external energy supply, the filter draws air in under a weather hood set low on the unit and directs it through an air-flow regulator tube to an oil control pan. Here the air picks up droplets of oil which are carried up through a diffuser cone where the air and oil are mixed and the air is scrubbed. The air then passes through a cylindrical filtration element where dirt particles and oil droplets are removed, permitting only clean, oil-free air to flow to the engine, blower, or compressor.

Oil and the dirt it has collected flow down inside the filtration element and through oil-return pipes to the sump where dirt settles out. Clean oil is metered from the top of the reservoir into the oil control pan through calibrated holes in the sides of the pan.

The air-flow regulator tube is preset at the factory so that, within a filter's rated capacity range, air velocity will be sufficient to insure full oil-washing, yet will keep the pressure drop low.

The smallest of the four models recommended for variable speed engines and compressors has a capacity range from 800 to 3500 cfm with a pressure drop of 0.6 inches of water minimum and 4.8 inches of water maximum. The largest of the models for constant speed engines and compressors ranges in capacity from 16,500 to 24,000 cfm with a pressure drop ranging from 1.9 to 3.5 inches of water.

A bulletin describing the oil bath filter; listing sizes, capacities and pressure drops; explaining the selection of the correct filter size; and detailing the servicing procedure is available.

More information? Circle Item 34 on postcard, page 85.

(*Continued on page* 110)

Snow doesn't melt over GILSULATE® covered underground steam lines

Steam line with 5" partial dirt backfill—steam turned into line. A light snow fell during the evening and still remained late the following day.

Indianapolis Power & Light Company chose GILSULATE for a recent installation on a busy downtown Indianapolis street. In addition to its outstanding insulating efficiency—snow didn't melt over a partially insulated line—and corrosion protection, GILSULATE's high loading capacity makes it the ideal choice for such an installation. The 6" line runs for 185 feet directly under the sidewalk, at an average trench depth of 4'6".

Nine tons of GILSULATE (type B for 300-385° F. temp. range) were used; only 100 man-hours were required to complete the job exclusive of excavation and backfill.

More and more, architects, engineers and contractors are discovering the *versatility* of GILSULATE.

For schools, railroads, hospitals, airports, utilities, housing projects—for big jobs or small—GILSULATE provides permanent corrosion protection for hot underground pipes at a cost far below that of any other pipe insulation system.

Investigate the value of this dependable, easily-installed, low-cost GILSULATE. Use the coupon below or see your local GILSULATE distributor.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
134-A West Broadway, Salt Lake City 1, Utah — or — 1145 East Jersey St., Elizabeth 4, N. J.

Send me more information on GILSULATE Insulation

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

AHV

(*Continued from page* 108)

Stainless Steel Lavatory Sink

A lavatory sink is added to the line of sinks made by Legion Stainless Sink Corp., Long Island City, N. Y.

Made of one piece seamless drawn stainless steel, the sink is designed for use in factory-built bathroom base units, as an auxiliary sink in multi-bathroom homes,

homes with large kitchens and playrooms, and for hospital, school, or institutional use.

The sink is constructed with a 2-in. flange around its top and a back splash. It measures 15 by 18 in. around the flange and has inside dimensions of 10 by 14 by 5 in. deep. It weighs about six pounds.

A hole is provided for a pop-up waste, and the faucet holes are drilled as specified.

More information? Circle Item 35 on postcard, page 85.

Cold Piping Insulation

A low temperature pipe insulating material that does not require wiring, pointing, or painting is introduced by Armstrong Cork Co., Lancaster, Pa.

Called LT cork covering, the insulating material is made of segments of the company's Corkboard adhered to a backing of asbestos and aluminum laminated paper. The asbestos paper provides a fire-resistant finish, while the vaporproof aluminum foil seals out moisture vapor.

The covering is applied by wrapping it around low temperature lines and using an adhesive to seal the lap, thus eliminating the necessity for bands, staples, or wire. In applying the material to fittings, workmen can saw the cork covering to the needed shapes and sizes on the job. The white asbestos exterior jacket of the material makes finish painting unnecessary on indoor installations.

The elimination of the need for staples and wire not only cuts installation time but also eliminates the danger of puncturing the aluminum laminated paper vapor barrier, preventing condensation and frosting. An additional advantage is that if lines are to be switched at any time, the insulating material can be removed and reused.

To facilitate its handling during shipment and on the job, the cork covering is cut in 36-in. lengths to fit various sizes of iron pipe or copper tubing from ⅛ in. up. It is manufactured in three standard thicknesses to meet varying temperature requirements. LT-Thirty is made in 0.8-in. thickness for use on lines operating at 30 deg F or higher. LT-Zero, 1.5 in. thick, is for lines operating as low as 0 deg. LT-Minus Thirty, for use on lines operating at temperatures as low as 30 deg below zero, is made 1.5 in. thick for pipes up to 1¼ in. IPS; 2 in. thick for pipes to 8 in. IPS; and 2¼ in. thick for larger pipe sizes. For temperatures below −30 deg, special thicknesses are available on order.

More information? Circle Item 36 on postcard, page 85.

Larger Size Air-Cooled Condensers

Remote-type, air-cooled condensers are being made available by Kramer Trenton Co., Trenton, N. J., for installations beyond 200 tons.

The constant demand by the industry for larger sized air-cooled condensing applications dictated the development of the large-sized units. They are also available for air-to-air heat pump application; thus making possible large heat pump applications without the use of water.

When used with the company's patented Winterstat, an adequate minimum head pressure is automatically maintained all the way to the expansion valve regardless of the outside air temperature. It eliminates any seasonal or daily adjustments, according to company officials.

More information? Circle Item 37 on postcard, page 85.

Combustion Test Kit

A portable kit for checking overall combustion efficiency is offered by F. W. Dwyer Mfg. Co. Michigan City, Ind.

Designated No. 1100, the kit checks carbon dioxide content, draft, stack temperature and smoke in gas-, oil-,

or coal-fired installations—commercial, industrial, and residential. Once set up, the gages can be read in thirty seconds. It reads to plus or minus ½ of 1% carbon dioxide.

Information about the kit is contained in new 4-page illustrated bulletin.

More information? Circle Item 38 on postcard, page 85.

(*Continued on page* 112)

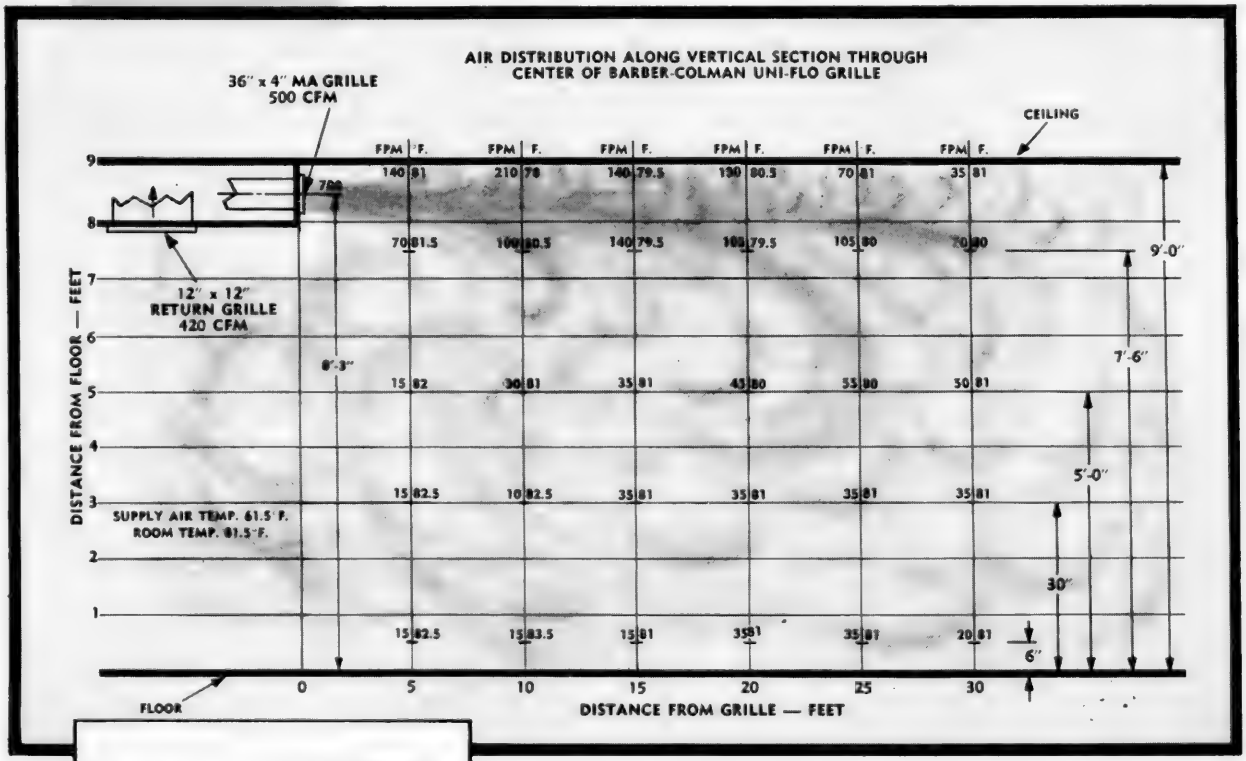
THE MARK OF QUALITY

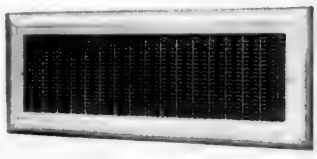
BARBER COLMAN

uni-flo

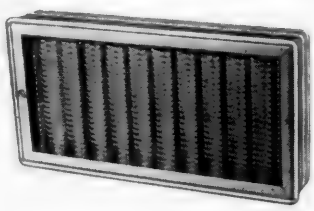
Engineered
Air Distribution

predict and deliver air patterns like this...





Model MA
Double-Deflection Grille



Model FA
Double-Deflection Grille

Precision distribution of conditioned air from sidewall grilles is no problem when you specify Uni-Flo. Uni-Flo Grilles are true sidewall diffusers, designed to give adjustable air pattern and rapid diffusion without air stream drop or excessive air motion. Laboratory-tested, field-proved performance data permit the engineer to create required conditions without guessing. Variety of types available. For complete details, call your nearby Barber-Colman Field Office, or write . . .

Barber-Colman Company

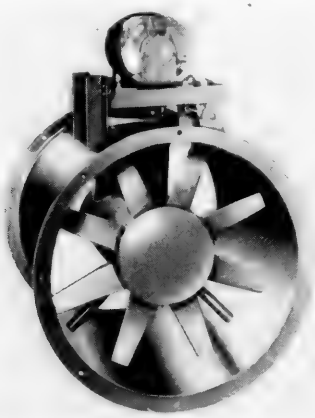
DEPT. G, 1102 ROCK STREET, ROCKFORD, ILLINOIS, U. S. A.
Field Offices in principal cities

(*Continued from page* 110)

Axial Flow Fans

A series of axial flow fans with wider blades to produce higher pressure characteristics with less operating noise are introduced by Detroit Blower Corp., Chicago, Ill.

The fans have hub-tip ratios that enable the larger blade angles near the hub to produce a pressure equal to that against which the unit as a whole is working. The blade



angles decrease to small values at the tip. As a result the more even delivery of air velocity across the entire fan blade eliminates back flow that might occur around the hub.

The welded steel wheels are available with 4, 6, and 8 blades.

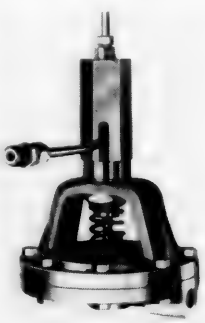
Both belt driven and direct driven models are available. Cradle-slung floor units, extended shaft models, adjustable-height floor stand fans for individual cooling, and larger models for industrial cooling demands are included in the line.

Fan diameters run from 12 to 72 in. and have an air moving capacity of 1200 to 100,000 cfm.

More information? Circle Item 39 on postcard, page 85.

Process Flow Valve

A valve has been designed by George W. Dahl Co., Inc., Bristol, R. I., for handling erosive process flows or flows containing gritty solids which cannot tolerate pockets but accept Neoprene or natural rubber. It is for use on slurry service where the solids in suspension tend to plug the conventional type control valve.



The only parts exposed to wear in the valve, called Sphincter, are a rubber seat and an O-ring. The seat is compressed along its axis to produce throttling action and tight closure. An adjustable travel stop is incorporated to prevent excess pressure on the seat.

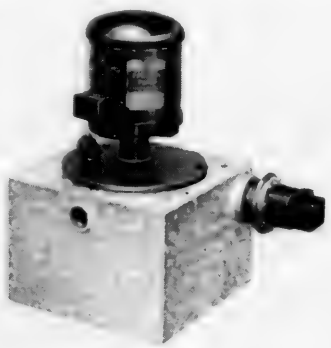
At present, ⅜- and ¼-in. OD tubing sizes are available. Parts exposed to the process may be bronze, steel, or stainless steel. Manual or air operators are available for quick interchange, when desired.

More information? Circle Item 40 on postcard, page 85.

Condensate Disposal Unit

An improved model air conditioning condensate removal unit is announced by Federal Pump Corp., Brooklyn, N. Y.

Designated MMC-1, the unit now has a float-operated, high water cutout and an alarm switch incorporated in its design.



Should the liquid in the receiver tank rise to a dangerous level the float operated switch will open the circuit to the air conditioner's magnetic starter, thereby shutting the unit down. The normally-open switch will close simultaneously and can be used to actuate an alarm, either visual or audible.

The motor is equipped with a built-in thermal protective device. Single phase units are available for either 115 or 230 v.

More information? Circle Item 41 on postcard, page 85.

Classroom Sinks

A line of stainless steel, classroom sinks are offered by Just Mfg. Co., Franklin Park, Ill.

Available in various sizes and models, the sinks' features include: welded, seamless construction; all interior corners rounded; flanges and interior surfaces hand polished; underside sound deadened.

The sinks are suitable for lower grades in elementary schools and may serve as drinking fountains and wash-up areas after working with paints, clay, and paste. They are also suitable for secondary schools in science rooms, art rooms, home economics departments, and lunchrooms.

The sinks are furnished with either stainless steel crumb cup strainers or chrome plated brass flat strainers (1½-in. tailpiece), as desired. Special sizes and special drain and faucet punchings are available on request.

Bulletin J655 gives the dimensions and specifications of the sinks.

More information? Circle Item 42 on postcard, page 85.

(*Continued on page* 114)

UNIFORM THREADING OF YOUNGSTOWN PIPE

makes your job easier, quicker

. . . yet more efficient

7 Points of uniform goodness in YOUNGSTOWN PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

Pipe fitting can be trouble free when threads are perfect. Couplings, tees, elbows roll on smoothly with no effort, tighten up with leakproof sureness. There aren't any stoppages or delays--no rattled nerves, no skinned knuckles, no recut threads. You've a quality job and satisfied customer.

You'll appreciate the uniform threading point of goodness -- like the other 6 points of uniform goodness -- in Youngstown Pipe. That's why it will pay you to specify Youngstown for all your pipe needs.

Youngstown PIPE

QUALITY V YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices Youngstown, Ohio District Sales Offices in Principal Cities

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

(*Continued from page* 112)

Reel Holds Extension Cord

To prevent extension cord tangling and storage problems, a large-capacity cord reel, called the Handyreel, is offered by Lakeshore Products, Woodinville, Wash.

Designed for home, workshop, and farm use, the reel supplies current up to 300 ft for electric power tools, saws, drills, lights, pumps, and mowers. It consists of a steel drum on a welded stand, with an adjustable brake and a carrying handle.

The capacities of the reel are: 300 ft of No. 16 cord and 200 ft of No. 14. It is 14 in. wide and stands 12⅜ in. high.

More information? Circle Item 43 on postcard, page 85.

Vane Rails Offered in Coils

Rails for air turning vanes are available in 100-ft coils from Duro-Dyne Corp., New Hyde Park, N. Y.

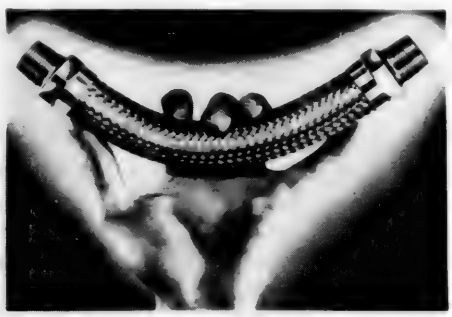
Previously available in flat bundles only, the vane rail is now packed one coil per carton. The user can pull out the length of vane needed from the coil, thereby eliminating waste due to end pieces.

The air vanes made with the rails are used in square duct turns to guide the air around the corner.

More information? Circle Item 44 on postcard, page 85.

Flexible Tubing Connector

A seamless drawn, flexible bronze tubing connector, called Flexline, are made by Packless Metal Hose, Inc., New Rochelle, N. Y., to control expansion, absorb vibration, deaden noise, and prevent leaks in hot water and steam heating systems.



Machined fittings, attached with high temperature brazing material, allow the connectors to be used for high temperature steam applications.

More information? Circle Item 45 on postcard, page 85.

Small Motor Valves

A series, the HO, of Hydramotor valves for zone control in heating and air conditioning systems and for hot and chilled water applications is announced by General Controls Co., Glendale, Calif.

Smaller in size and capacities, generally, than the company's standard H-1, H-2, and H-3 series, the valves are adaptable to a diversified group of commercial and light industrial uses, for example, to provide on-off control with shutoff of gas, oil, liquids and steam. The valves provide for remote control in response to thermostats, limit or operating controls, remote switches, or paralleling with motor driven burners and fans.

An electric motor hydraulic actuator eliminates the need for reduction gears, is hermetically-sealed, and positioned in line with the valve for more compact installation. Normally open or normally closed and three-way types operate against a heavy return spring, incorporating a two-wire circuit that automatically returns to the de-energized position in the event of a power failure.

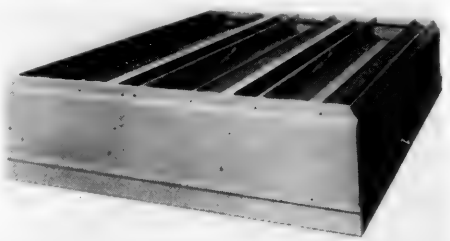
Operating pressures up to 300 psi are obtainable with iron or bronze valve bodies. The series is standard with a spring-loaded, Teflon, packing gland.

More information? Circle Item 46 on postcard, page 85.

Gravity Flow Ventilator

A gravity flow ventilator is made by The Swartwout Co., Cleveland, Ohio.

Named the Contouramic Airmover, the ventilator is 21½ in. high above the roof curb. Its air-moving capacity is 7% greater than previous models.



The damper control is standardly equipped with fusible links which permit the weighted dampers to open automatically in case of fire, when the links melt at 160 deg F. The unit is weatherproof, and drainage runs directly to the roof on both sides.

An improved base structure simplifies mounting on concrete, wood, or steel curbs built on the roof. The unit may be installed in single units for spot ventilation, or in continuous runs to any length desired.

Form No. 312 describes construction and installation methods.

More information? Circle Item 47 on postcard, page 85.

(*Continued on page* 116)

At the magnificent
FONTAINEBLEAU
Miami Beach, Florida

Morris Lapidus, Architect, New York and Miami Beach; Sasnett & Bennett, Consulting Engineers, Miami.

. . . the most elaborate provision for human comfort ever devised depends on PETRO oil firing for heat

Each guest in the luxurious new Hotel Fontainebleau can select the temperature for his own suite—whether for heating or cooling.

Down to the smallest detail, this $15,000,000 building represents a thorough search for the best that America can provide in equipment, furniture and fittings. The particular quality that won a place for Petro oil firing equipment in this select company was its proved DEPENDABILITY in precision firing of a difficult fuel—low cost heavy oil.

A whole firing system in one package

The Petro units shown here go far beyond the usual oil burner—they are complete combustion systems with matched Kewanee boilers engineered for this particular use. The result is a fully integrated boiler-burner unit with every component built in — control panel with instruments factory mounted, wired and tested, forced draft air supply, fuel system—all under one contract and one responsibility.

For gas, oil or combination gas-oil firing

Standby oil equipment is required in many areas where gas is the principal fuel. But the ability to switch fuels quickly is a great advantage whether required or not. It protects against fuel emergencies and cuts fuel costs. Petro models are available for single or dual fuel firing in a wide range of sizes.

For further information mail the coupon, or look in the yellow pages of your telephone directory for the nearest Petro dealer.

Three Petro forced draft oil burners with matched Scotch type boilers in the Fontainebleau boiler room. This plant supplies domestic hot water in addition to steam for heating and laundry. Petro distributor: Florida Fuel Oil Co., Miami.

PETRO
T. M. REG. U. S. PAT. OFF.

Over 50 years of leadership in automatic heating and power equipment

PETRO
3223 West 106th Street, Cleveland 11, Ohio
In Canada: 2231 Bloor St., West, Toronto, Ontario
Please send the 20-page illustrated Petro catalog.

Name _____

Company _____

Address _____

City _____ State _____

(*Continued from page* 114)

Booster Heats Washwater

Dishwasher booster heaters are made by Wesix Electric Heater Co., San Francisco, Calif., to provide 180 deg F water necessary for the proper operation of commercial dishwashing equipment to meet National Sanitation Foundation standards.

Available in 5- and 12-gal capacities and in wattages ranging from 5000 to 29,000 watts, the booster heaters, in normal use, raise the water temperature from 140 to 180 deg.

The water tank, formed of galvanized steel with an outer shell, is constructed of 18-gage steel with a finish of baked, hammertone-grey enamel. The low square shape of the heater permits installation under a counter adjacent to the dishwashing unit.

Electrical connections are accessible by removing a plate on the front of unit. Thermostats automatically turn the heating elements on and off to maintain a set temperature. No separate contactors are required.

More information? Circle Item 48 on postcard, page 85.

Six-Inch Dual Fuel Burners

A dual-fuel burner (No. 214-84) with a 6-in. air pipe connection is added to the line of Fire-All burners available from The North American Mfg. Co., Cleveland, Ohio. At 16 ounces per square inch (27.7 inches of water) air pressure the burner's capacity is 4,850,000 Btu per hr, equivalent to about 4850 cfh of natural gas or 35 gph of oil.

All six sizes of the series of burners produce a stable fire on light-up without the need for a constant pilot. They will operate in cold, tight furnaces under positive pressure. Atomizing air may be left on during gas operation to give capacity equal to that obtained with light or heavy oil.

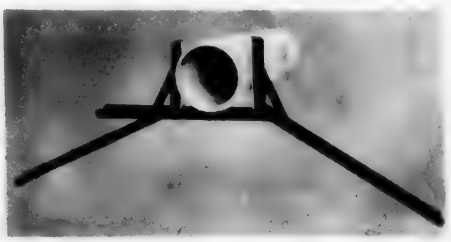
The 4-pipe burners have a provision for mounting flame safety devices such as a flame, rod, photo cell, or flicker cell. They are furnished with an observation port with tubing and fittings to introduce some atomizing air into the mounting to keep the port clear at all times for good observation.

Bulletin 214, recently issued, describes the burners, showing photos of installations. Data sheet DF-214 gives burner capacities, dimensions, operating information, and prices. Both sheets are available upon request.

More information? Circle Item 49 on postcard, page 85.

Gravity Grip Pipe Vise

A new model gravity grip pipe vise, designed to hold asbestos-cement and clay pipe, is available from Spring Load Mfg. Corp., Seattle, Wash.



Designated Model V-20, the vise holds the pipe at a convenient working height and angle. It adjusts to hold from 4- to 20-in. pipe.

While especially designed for use with the company's pipe cutters, machining and tapering tools, it works equally well with similar tools.

Its shipping weight is 48 lb.

More information? Circle Item 50 on postcard, page 85.

Masonry Drill

A portable diamond core drill which is applicable to mining, construction, highway, and plumbing contractor's assignments is placed on the market by Pennsylvania Drilling Co., Pittsburgh, Pa.

Designated Model E, the drill bores holes vertically, horizontally, or at an angle from ½ to 6½-in. in diameter and up to 19 in. deep in one operation. It drills such materials as asphalt, marble, granite, brick, and glass. Such metallic items as reinforcing bars, pipe, conduit and I-beams which might be encountered can also be drilled.

Effective in reinforced concrete, the drill reduces the time needed to bore through masonry walls and floors for running pipe, conduits, or electric lines. It is powered by a 1500-watt electric plant manufactured by Kohler Co., Kohler, Wis. Either a 115-v a-c or d-c generator is optionally furnished with the rig.

More information? Circle Item 51 on postcard, page 85.

(*Concluded on page* 118)

Dallas' new Decorative Center. Owner: Mr. Trammell Crow. Architect: Mr. Jacob Anderson. Builders and General Contractors: McFadden & Miller. G-E Distributor: Texas Distributors, Inc.

NEW DECORATIVE CENTER IN DALLAS SELECTS GENERAL ELECTRIC AIR CONDITIONERS

New proof that the merchandising-minded look to General Electric for the best in air conditioning! Now, it's the Decorative Center in Dallas, Texas—one of that progressive city's most important new business additions.

Designed and built to reflect the increasing significance of Dallas in American commercial life, this new center is "comfort serviced" by 22 G-E Packaged Air Conditioners, in various sizes amounting to 180 tons. In making the installation, Texas Distributors, Inc., General Electric distributors in Dallas, located units to give each tenant individual control of temperature and humidity. Total area serviced: 56,000 square feet.

An especially important feature of the G-E installation is its flexibility in meeting future air conditioning needs. The center has been planned to accommodate up to 100,000 more square feet, in which additional air conditioning units can be placed without any rearrangement of existing equipment.

Low-cost, dependable G-E Packaged Units provide maximum design freedom in new construction and modernization. All models may be used singly or in multiple to meet any air conditioning need. General Electric's famous 5-year warranty assures protection against service problems. For complete details, write: General Electric Co., Commercial & Industrial Air Conditioning Dept., Bloomfield, N. J.

Self-contained ceiling models
3 and 5 ton air-cooled
3, 5 and 7½ ton water-cooled.

Self-contained floor models—3, 5, 7½, 10 and 15 ton water-cooled.

packaged AIR CONDITIONERS

Progress Is Our Most Important Product

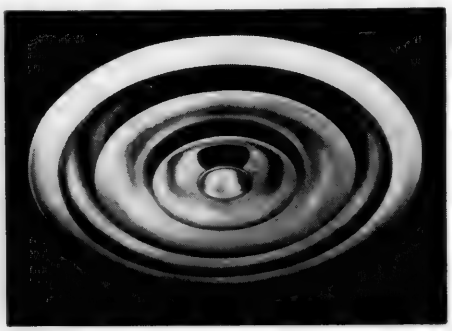
GENERAL ELECTRIC

(*Concluded from page* 116)

Adjustable Ceiling Diffusers

A line of ceiling diffusers and accessories is announced by Titus Mfg. Corp., Waterloo, Iowa.

A feature of the ceiling diffusers is that they may be adjusted for heating, ventilating, and cooling applications.



Any air pattern desired from directly downward to full horizontal—or any of the intermediate stages in between—can be obtained by turning, with the hand, the small center cone. This can be done without changing the relative positions of the three center cones, so that the diffusers present a uniform appearance in any room even if each diffuser is set for an entirely different air pattern.

All of the diffusers, regardless of model or size, have four cones to assure further uniformity of design.

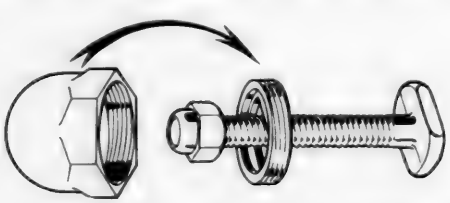
To install the diffusers, the center cone assembly, held in place by a positive locking device, is removed so that the outside cone can be fastened to the duct collar. A slight twist snaps the center cone assembly back into position.

The diffusers are available in all sizes in two models: Model TMA (fully adjustable) and Model TM (fixed cone). Both models can be used for exposed ductwork or flush mounting applications. The diffusers can be furnished with a line of accessories including the Model CC ceiling cone and Model AG-55 radial volume control damper.

More information? Circle Item 52 on postcard, page 85.

Closet Bolt Caps

Plastic closet bolt caps for toilet bowls or urinals are available from J. A. Sexauer Mfg. Co., New York, N. Y.



The closet bolt caps have a brass bushing (arrow) which takes the place of the plated brass washer normally used under the head of the bolt or screw. A slot in the brass bushing makes it adjustable to any desired position, so that the cap is properly located on any style of fixture. After the nut is installed and tightened, it holds the bushing firmly in place; the plastic cap is merely screwed on and the job is done.

When closet bolt caps are used, it is a simple matter to unscrew them when a toilet bowl or urinal is taken up or to re-install them when the fixture is reset.

More information? Circle Item 53 on postcard, page 85.

Office Air Conditioner

A 5-ton air conditioner that can be installed as a window unit or against an outside wall is being produced by General Air Conditioning Corp., Los Angeles, Calif.

Also manufactured in a 3-ton capacity size, the unit is flexible enough to be used in offices or multiple story buildings. All models come in one package completely assembled, charged and wired up. They are controlled by a thermostat and operate on power from a standard outlet.

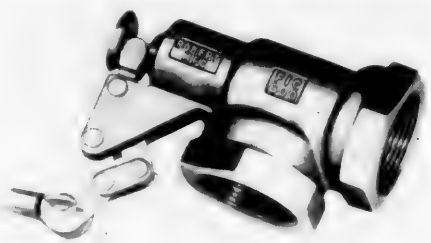
Available in several wood-grain finishes (illustrated) or steel grey, the units can be utilized to provide year-round air conditioning with a heat pump.

More information? Circle Item 54 on postcard, page 85.

Heavy Duty Float Valve

A heavy duty, compound lever, float valve is being made of brass in sizes 1¼ and 1½ in. by Robert Mfg. Co., Los Angeles, Calif.

Designated Fig. 600, the valve maintains liquid levels



with a positive shutoff. Its applications include large cooling towers or evaporative air conditioning units, evaporative condensers, industrial processing, water storage tanks, and livestock watering.

Because of the efficiency of the compound lever mechanism, a 6-in. diameter ball with a 10-in. stem will provide satisfactory operation at inlet pressures up to 150 psi.

More information? Circle Item 55 on postcard, page 85.

THE "EASIER" BOILER

Easier to insulate

Easier to erect

Easier to build combustion chamber

Easier to enlarge capacity

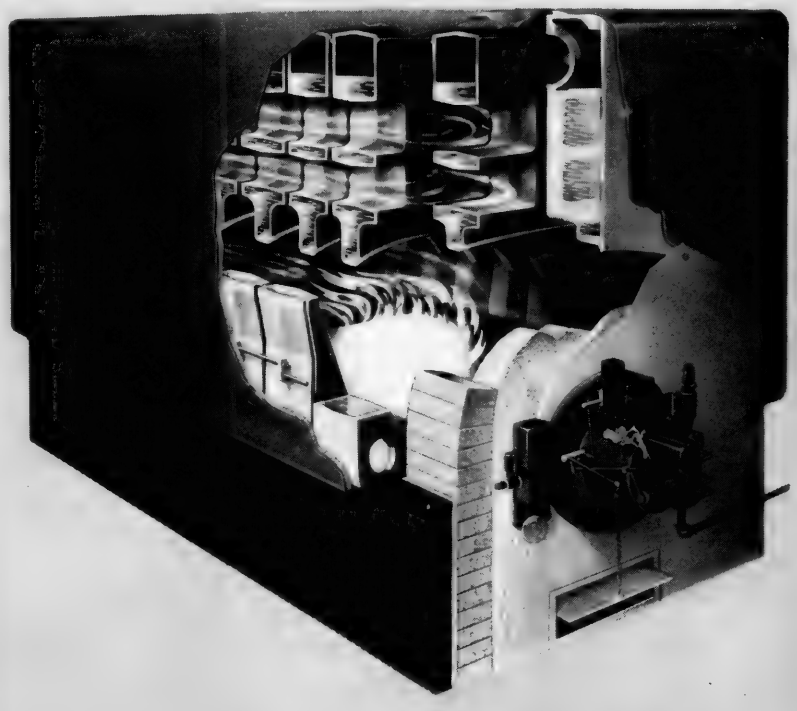
Easier to install breeching

Easier to install burner on special steel front plate

It is also easy to see why the Weil-McLain "HR" Series Boiler is completely outstanding for commercial, institutional and industrial installations.

This boiler was designed in cooperation with leading manufacturers of horizontal rotary oil burners and has their approval. The extra large combustion volume, greater primary heating surface, low heat release and balanced flue gas travel are among the features which contribute to highly efficient combustion and heat absorption. That's why the "HR" Boiler most effectively develops the economies obtainable with low-cost, heavy oils.

Cast iron sectional construction offers easier erection...less required space...easy enlargement of capacity...low maintenance cost and longer life. The special steel front of the "HR" greatly simplifies installation of the burner. A Weil-McLain *"extra value"* in every detail!



WEIL-McLAIN

HR SERIES BOILERS

FOR HORIZONTAL ROTARY OIL BURNERS

For complete data send for Bulletin C-188

WEIL-McLAIN BOILERS · RADIATORS

Address Literature requests to Dept. BB-76

WEIL-McLAIN COMPANY

MICHIGAN CITY, INDIANA

DEGREE-DAYS FOR MAY, 1956

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31, incl.*		
	1956	1955	Normal	1955-56	1954-55	Normal
Abilene, Texas (A)	0	0	0	2585	2265	2707
Albany, New York (A)	370	155	246	7343	6477	6888
Albuquerque, New Mexico (A)	20	90	70	3855	4347	4389
Alpena, Michigan (C)	487	322	437	7955	7290	7803
Anaconda, Montana (C)	(a)	719	567**	(a)	8182	8010**
Asheville, North Carolina (C)	58	32	105	4208	4063	4067
Atlanta, Georgia (A)	9	0	20	2876	2751	2826
Atlantic City, New Jersey (C)	284	160	189	5035	4643	4717
Augusta, Georgia (A)	8	1	0	2653	2537	2138
Baltimore, Maryland (C)	115	38	73	4444	4032	4203
Billings, Montana (A)	286	320	304	7525	6790	6959
Binghamton, New York (C)	308	183	240	6830	6144	6472
Birmingham, Alabama (A)	5	2	30	2859	2686	2788
Bismarck, North Dakota (A)	308	211	355	9960	8065	8851
Block Island, Rhode Island (A)	464	282	335	6081	5442	5720
Boise, Idaho (A)	225	353	249	5756	6466	5798
Boston, Massachusetts (A)	304	133	236	6096	5395	5742
Bozeman, Montana (C)	(a)	454	471**	(a)	8171	8195**
Buffalo, New York (A)	376	206	315	6885	6150	6720
Burlington, Iowa (A)	126	106	179	6364	5669	6067
Burlington, Vermont (A)	470	188	307	8109	7372	7727
Butte, Montana (C)	(a)	556	502**	(a)	8582	7926**
Cairo, Illinois (C)	35	2	47	3913	3533	3756
Charleston, South Carolina (C)	4	0	0	1886	1822	1769
Charlotte, North Carolina (A)	28	0	29	3255	3081	3205
Chattanooga, Tennessee (A)	10	6	45	3472	3276	3384
Cheyenne, Wyoming (A)	310	359	462	7155	6939	7317
Chicago, Illinois (C)	231	139	254**	5937	5396	6018**
Cincinnati, Ohio (C)	92	36	108	4568	4105	4532
Cleveland, Ohio (A)	265	126	223	6124	5379	5950
Columbia, Missouri (A)	75	54	135	5165	4521	5093
Columbia, South Carolina (A)	9	1	0	2708	2605	2284
Columbus, Ohio (C)	171	74	153	5509	4865	5255
Concord, New Hampshire (A)	453	216	316	7794	6911	7462
Concordia, Kansas (C)	94	26	146	5788	4895	5303
Dallas, Texas (A)	0	0	0	2328	2146	2272
Dayton, Ohio (A)	184	91	179	5836	5211	5552
Deer Lodge, Montana (C)	(a)	545	487**	(a)	8452	8347**
Denver, Colorado (A)	143	203	286	5745	5758	6051
Des Moines, Iowa (A)	149	80	201	6885	5962	6384
Detroit, Michigan (A)	310	154	251	6497	5793	6336
Devils Lake, North Dakota (C)	406	303	394	10,999	9106	9695
Dodge City, Kansas (A)	87	54	135	5166	4586	5043
Dubuque, Iowa (A)	242	160	267	7507	6760	7159
Duluth, Minnesota (C)	549	416	487	9823	9007	9217
Elkins, West Virginia (A)	233	179	224	6045	5675	5680
El Paso, Texas (A)	0	2	0	2244	2523	2641
Ely, Nevada (A)	444	525	418	7300	8016	7177
Escanaba, Michigan (C)	531	352	471	8413	7650	8334
Evansville, Indiana (A)	75	38	90	4727	4264	4354
Fargo, North Dakota	361	195	338	10,188	8643	9107
Fort Smith, Arkansas (A)	10	0	0	3475	3096	3188
Fort Wayne, Indiana (A)	225	131	226	6342	5652	6217
Fort Worth, Texas (A)	0	0	5	2391	2193	2361
Fresno, California (A)	49	87	43	2582	3039	2532
Galveston, Texas (C)	0	0	0	1019	990	1211
Grand Junction, Colorado (A)	71	163	145	5089	6145	5773
Grand Rapids, Michigan (A)	136	197	301	7030	6309	6948
Green Bay, Wisconsin (A)	402	267	347	8433	5658	8062
Greensboro, North Carolina (A)	69	20	50	4110	3785	3810
Greenville, South Carolina (A)	29	9	32	3245	3101	3060
Harrisburg, Pennsylvania (A)	202	80	128	5541	5019	5244
Hartford, Connecticut (A)	315	129	201	6507	5783	6094
Hatteras, North Carolina (C)	40	27	25	2846	2523	2392
Havre, Montana (C)	299	370	313	9109	7643	8030
Helena, Montana (A)	331	480	399	8472	8255	8005
Houston, Texas (C)	0	0	0	1152	1134	1276
Huron, South Dakota (A)	232	117	279	9138	7248	7796
Indianapolis, Indiana (A)	162	101	176	5768	5219	5581
Jackson, Mississippi (A)	0	0	0	2429	2233	2202
Kansas City, Missouri (A)	52	36	111	5022	4330	4880
Knoxville, Tennessee (A)	14	8	50	3750	3521	3590
La Crosse, Wisconsin (A)	242	133	250	8118	7039	7545
Lander, Wyoming (A)	298	319	396	7828	7546	8110

(a) Data not available.

*Heating season cumulative, from Sept. 1.

**Same normal figures as previously listed by HEATING AND VENTILATING since new figures are not available. All other normal figures in this table are based on a 30-year period covering 1921 to 1950, inclusive, recently compiled and published by the U. S. Weather Bureau.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company. Tacoma figures through the courtesy of the Tacoma News Tribune.

[Table concluded on page 122]

AIRCOUSTAT SILENCES ALL FREQUENCIES IN THE AUDIO-FREQUENCY RANGE!
Resonators hold low-frequency sounds
Periodic internal structure dampens middle-frequency noise
Sound-absorbent materials suppress high frequencies

AIRCOUSTAT* Sound Traps eliminate air conditioning noise at 50% less cost

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INDUSTRIAL SOUND CONTROL

Engineered* Products Sold with *Service

MAIL THIS COUPON TODAY

KOPPERS COMPANY, INC., Metal Products Div., Industrial Sound Control Dept., 6307 Scott St., Baltimore 3, Md.
Gentlemen: Please send me a free copy of your booklet on AIRCOUSTAT Sound Traps.

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City..... Zone..... State.....

Degree-Days for May, 1956 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

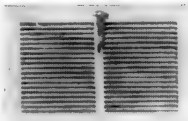
City	May			Season to May 31, incl.*		
	1956	1955	Normal	1955-56	1954-55	Normal
Lewiston, Maine (O)	459	217	693	7501	6973	7662
Lincoln, Nebraska (C)	111	45	172	6273	5429	5826
Little Rock, Arkansas (A)	12	0	18	3117	2846	2982
Livingston, Montana (C)	(a)	373	405**	(a)	7263	7043**
Los Angeles, California (C)	74	88	68	1511	1250	1432
Louisville, Kentucky (A)	90	32	94	4507	4148	4434
Lynchburg, Virginia (A)	108	50	82	4429	4106	4148
Macon, Georgia (A)	0	0	0	2260	2158	2049
Madison, Wisconsin (C)	269	159	266	7391	6730	7181
Marquette, Michigan (C)	560	351	477	8311	7645	8184
Memphis, Tennessee (A)	7	0	24	3255	3028	3137
Meridian, Mississippi (A)	1	0	9	2445	2371	2333
Milwaukee, Wisconsin (A)	370	229	351	7169	6490	7044
Minneapolis, Minnesota (A)	246	124	259	8558	7409	7748
Moline, Illinois (A)	155	100	199	6583	5946	6311
Montgomery, Alabama (A)	0	0	0	2280	2218	2137
Nantucket, Massachusetts (A)	(a)	(a)	394	(a)	(a)	5907
Nashville, Tennessee (A)	21	5	43	3735	3519	3513
New Haven, Connecticut (A)	355	180	261	6186	5578	6186
New Orleans, Louisiana (C)	0	0	0	1171	1116	1175
New York, New York (C)	261	100	153	5320	4824	5032
Newark, New Jersey (A)	218	79	148	5433	4864	5241
Norfolk, Virginia (A)	121	58	59	3698	3417	3454
North Platte, Nebraska (A)	183	140	243	7166	6470	6470
Oak Ridge, Tennessee (C)	22	14	58	3856	3806	4028
Oakland, California (A)	185	232	212	3145	3117	2883
Oklahoma City, Oklahoma (A)	14	5	38	3912	3387	3519
Omaha, Nebraska (A)	114	55	175	6550	5582	6123
Parkersburg, West Virginia (C)	(a)	63	119	(a)	4611	4737
Peoria, Illinois (A)	124	90	192	6077	5509	6035
Philadelphia, Pennsylvania (C)	163	50	93	4871	4354	4523
Phoenix, Arizona (A)	0	3	0	1318	1436	1492
Pittsburgh, Pennsylvania (C)	184	88	137	5279	4717	5035
Pittsfield, Mass. (A)	460	240	336	7953	7094	7501
Pocatello, Idaho (A)	253	403	317	6814	7745	6840
Portland, Maine (A)	516	289	394	7855	6987	7493
Portland, Oregon (C)	161	316	199	4318	4361	4046
Providence, Rhode Island (A)	365	185	258	6355	5633	6041
Pueblo, Colorado (A)	98	138	203	5506	5296	5682
Raleigh, North Carolina (A)	65	17	29	3742	3389	3075
Rapid City, South Dakota (A)	270	203	357	7604	6655	7331
Reading, Pennsylvania (C)	197	62	123	5310	4773	5044
Red Bluff, California (A)	84	53	51	2658	3023	2546
Reno, Nevada (A)	309	355	318	5921	6413	5783
Richmond, Virginia (A)	107	67	66	4213	3872	3955
Rochester, New York (A)	407	205	289	7187	6352	6766
Roswell, New Mexico (A)	6	16	28	3436	3397	3424
Sacramento, California (C)	69	79	85	2421	2942	2595
St. Joseph, Missouri (A)	77	50	101	5180	5051	4692
St. Louis, Missouri (C)	66	20	94	4640	4107	4462
Salt Lake City, Utah (A)	172	257	233	5560	6389	5785
San Antonio, Texas (A)	0	0	0	1456	1227	1579
San Diego, California (A)	57	103	97	1509	1326	1513
Sandusky, Ohio (C)	265	129	217	6090	5302	5818
San Francisco, California (C)	238	261	248	2681	2749	2523
Sault Ste. Marie, Michigan (A)	633	376	499	9140	8365	9016
Savannah, Georgia (A)	1	0	0	2006	2020	1710
Scranton, Pennsylvania (A)	338	170	196	6765	5782	5994
Seattle, Washington (C)	179	363	246	4683	4486	4237
Sheridan, Wyoming (A)	308	342	387	7940	7346	7674
Shreveport, Louisiana (A)	0	0	0	2190	2042	2117
Sioux City, Iowa (A)	154	61	228	7407	6237	6933
Spokane, Washington (A)	252	478	330	6994	7017	6661
Springfield, Illinois (A)	120	75	127	5743	5070	5211
Springfield, Missouri (A)	62	28	118	4803	4245	4669
Syracuse, New York (A)	386	193	247	7172	6354	6454
Tacoma, Washington (C)	194	322	282	4783	4609	4595
Toledo, Ohio (A)	271	145	245	6684	5740	6322
Topeka, Kansas (C)	59	36	112	5249	4566	4906
Trenton, New Jersey (C)	209	79	133	5324	4819	5057
Tulsa, Oklahoma (A)	29	0	44	3765	3186	3584
Utica, New York (O)	393	215	253**	7417	6808	6795**
Valentine, Nebraska (A)	241	144	288	7901	6549	6971
Walla Walla, Washington (C)	158	281	171	5335	5053	4810
Washington, D. C. (C)	115	34	80	4414	4047	4258
Wichita, Kansas (A)	52	14	101	4891	4203	4564
Williston, North Dakota (C)	338	297	360	9735	8173	8859
Winnemucca, Nevada (A)	307	402	299	6282	7188	6241
Yakima, Washington (A)	154	332	186	6583	6129	5599

For footnotes, see page 120.

sure signs of indoor comfort!

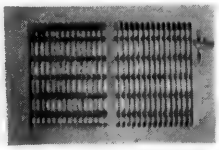
Standard Registers & Grilles

. . . for custom control of warm air heating



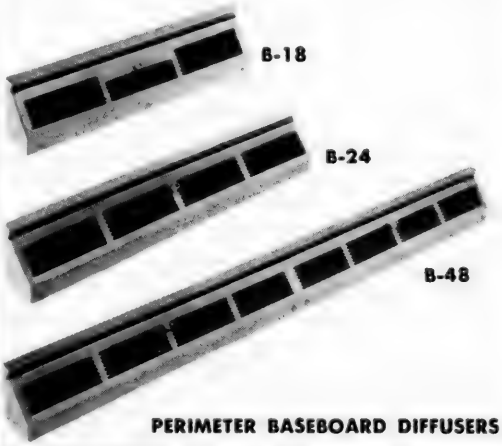
#41 H
WALL

SINGLE DAMPER FORCED AIR REGISTERS



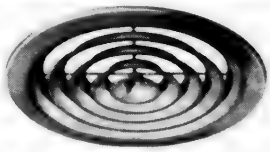
#331
WALL

MULTIPLE VALVE SIDEWALL & BASEBOARD REGISTERS

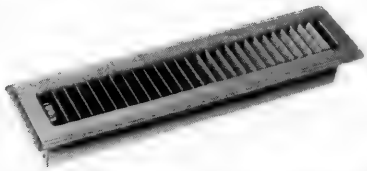


PERIMETER BASEBOARD DIFFUSERS

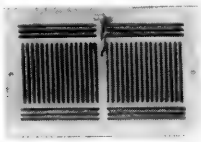
. . . for uniform, year-around heating and cooling comfort



CEILING AIR DIFFUSERS (flush and extended)

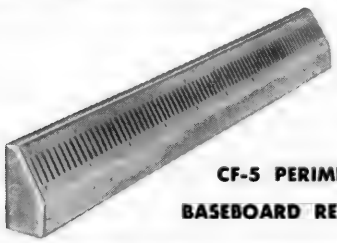


PH SERIES PERIMETER FLOOR REGISTERS



#551
WALL

PERIMETER BASEBOARD REGISTER NO. 551



CF-5 PERIMETER BASEBOARD REGISTERS

Also: return air grilles, baseboard and sidewall intakes, air cond. and ventilating returns, door grilles, floor registers, cold air faces, frames, ornamental metals.

Install Standard Registers and Grilles on every job to save time and increase customer satisfaction.

STANDARD STAMPING

. . . first in engineering for indoor comfort!

Standard Stamping & Perforating Co.
3141 W. 49th Place, Chicago 32, Illinois

Gentlemen: Please send me your new catalog showing the complete line of Standard Stamping Registers and Grilles.

Name_____

Company_____

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City_____ Zone____ State_____

IN THE FIELD

W. A. Crowder, Seattle, Wash., has been named exclusive representative for the Connor Engineering Corp. line of residential ceiling air diffusers for Washington, Oregon, and Idaho.

The Trane Co., La Crosse, Wis., has appointed **Roger Burtness** manager of its Billings, Mont., sales office. Mr. Burtness joined the company in 1950 as a sales engineer in the Billings office.

Snell Refrigeration Supply Co., Dallas manufacturers' representative, has been appointed distributor of Dravo Corporation heating equipment for a 53-county area in Texas. The Snell Co. will sell and service Dravo's line of oil- and gas-fired units.

The opening of a Milwaukee branch office and the appointment of **Wayne Norin** as its manager are announced by The Powers Regulator Co., Skokie, Ill. **Robert F. Cummings** was appointed branch manager of the newly-established Omaha office, and **Charles E. Brandes** and **Joseph H. Richards** were assigned as resident engineers to the Dayton and Columbus offices, respectively.

William A. Preininger has been appointed district manager of Mueller Brass Company's Denver, Colo., sales territory. The company also assigned the following sales representatives: **George I. Duddy** to the Cincinnati office; **Richard J. Williams** to the Dallas office; **John G. De Nardin** to the Indianapolis office; and **Wayland Swanson** to the Chicago wholesale distributing office.

Four Weathertron distributors have been named in the State of Texas by General Electric Co. as retailer-wholesalers for its heat pump. They are: **Wheeler-Rhodes Air Conditioning Co.** in McAllen; **Austin Air Conditioning Co., Inc.,** in Austin; **Texas General Air Conditioning Co.** in Corpus Christi and **Kerr Lumber Co.,** in San Antonio.

W. L. Lashley & Associates have been appointed sales representatives in Houston, Tex., and the surrounding trade area for Kennard Corp., St. Louis, Mo. They will represent Kennard on its line of air conditioning products.

Bush Mfg. Co. and Heat-X, Inc., have announced appointment of **Robert T. Thorpe** as a sales engineer to cover the North Boston, New Hampshire, and Maine area.

A. W. Cash Co., Decatur, Ill., has announced the appointment of **Erickson Industrial Products Co.,** Dallas, Tex., as north central Texas representative for Cash Standard valves, controllers, governors and regulators, and Stacon temperature regulators.

The naming of **Raymond L. Griggs** as field engineer for the Columbus (Ohio) district has been announced by Airtemp Div., Chrysler Corp. Mr. Griggs' headquarters will be the company's regional sales office in Dayton, Ohio.

Si Williams has been appointed sales representative of Baltimore Aircoil Co., Inc., for northern Ohio and western Pennsylvania. Mr. Williams recently held the position of manager of product research in the Research Division of Whirlpool-Seeger Corp.

Thomas Zurick has been appointed sales representative for Marsh Instrument Co., Skokie, Ill., in the state of Indiana. He will direct his efforts toward original equipment manufacturers and refrigeration wholesalers.

Marketing of Pacific steel boilers and other heating products produced by Pacific Steel Boiler Division, Johnstown, Pa., has been expanded in eastern Pennsylvania by the appointment of **Du-Ross Anderson Company,** Scranton, Pa., which is now representing the Division through the Scranton office as well as through branch offices in York and Wilkes-Barre, Pa.

Seth M. Snyder has been appointed manager of the Charlotte, N. C., district sales office of The Babcock & Wilcox Company's Boiler Division. At the same time, the company's Charlotte sub-office has been elevated to full district office status.

A new branch office has been established in Houston, Tex., with **William Thorrat** as branch manager by Wheelco Instruments Div., Barber-Coleman Co. **Harold S. Hern** has joined the sales-service staff in Baltimore. New sales engineers announced are **John C. Twomey,** Baltimore, and **Walter A. White** and **Robert G. Steel,** Chicago. New service engineers are **Henry T. Clinkaberry** and **Robert D. Getzelman,** Los Angeles, and **Charles E. McGoff,** St. Louis.

A. J. L. Moritz, Jr., formerly residential air conditioning and heating merchandising manager for Airtemp Div., Chrysler Corp., has joined Air Conditioning Distributors, Miami, Fla., as general manager.

Bob McElwain has been appointed Southeast regional sales manager for Bryant Division of Carrier Corp. Mr. McElwain has his headquarters in Atlanta, Ga.

George I. Kalish has been appointed zone sales supervisor for York Corporation's North Atlantic district, with headquarters in New York. Mr. Kalish will contact wholesale distributors of York room air conditioners in New York, New Jersey, Rhode Island and Massachusetts.

Paul M. Thomas of Dallas, Tex., has been promoted to the position of Midwestern regional manager for Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp. Mr. Thomas, who has been district manager since 1949, will succeed G. Townsend Underhill. To succeed Mr. Thomas in Dallas, the company has promoted **Alfred M. Johnson**, an outside salesman in the St. Louis, Mo., territory to the position of district manager.

W. K. Stauffer, formerly manager in charge of the Philadelphia branch of The Mercoid Corporation has been elected vice-president in charge of the Eastern area. **R. F. Fisher,** vice-president (formerly in charge of the Eastern area) is being transferred to Los Angeles where he will supervise the sales activities for the West Coast area. **John Sheddon** was appointed manager of the New York branch and **F. W. Ayer** as manager of the Philadelphia branch.

The appointments of **W. Y. Humphreys** as Pittsburgh district manager and **E. F. Morse** as Cleveland district manager have been announced by Sturtevant Div., Westinghouse Electric Corp.

Even your tricky pipe racking is easier with UNISTRUT® channel

Typical service tunnel in large Midwest university

You make more money with UNISTRUT channel, too—by saving time, men and materials on this foolproof, superior method of pipe racking.

You start with everything you need—channel, clamps, hangers, concrete inserts, rollers or any other accessories. Everything is provided by UNISTRUT from standard stock.

Next, you forget about drilling, welding or riveting. With UNISTRUT, you simply cut the channel to length...slip the UNISTRUT nut in the channel slot...and tighten with a wrench. That's it!

Correct slope or pitch? No problem at all with UNISTRUT—it's completely adjustable. Future alterations or additions? With the flexible UNISTRUT System, you can make them any time.

Study these advantages a few moments—and you'll see why thousands are switching to the modern, high-speed UNISTRUT System for superior support of steam, gas, light conduit, air conditioning or heavy water lines. Get the facts now! Write for 78-page illustrated Catalog 700 giving complete information. Consult your telephone directory today for the name of your nearest UNISTRUT Distributor.

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NEW CATALOGS

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

FAN BULLETIN—Two bulletins with data on a line of Class I and Class II centrifugal fans have been revised by The Trane Co., La Crosse, Wis. Bulletin 3DS-348B covers backwardly inclined blades and Bulletin DS-348F forward curved blades. ----------**Item 56**

SWIMMING POOL DATA—A revised edition of Bulletin WC-109A on equipment for swimming pools is available from Graver Water Conditioning Co., New York, N. Y. The 12-page illustrated brochure describes the component parts of the recirculation and purification system needed to supply water for swimming pools. ----------**Item 57**

REGISTER CATALOG—A catalog (No. 57) of air conditioning registers, grilles, and diffusers is published by A-J Mfg. Co., Kansas City, Mo. The 32-page catalog lists the company's full line and gives engineering data. ----------**Item 58**

ROOM COOLER BULLETIN—A bulletin describing and illustrating a window type, room air conditioner is available from National-U. S. Radiator Corp., Johnstown, Pa. In addition to the illustrations, the catalog lists the dimensions and specifications of three models. ----------**Item 59**

CONTROL VALVE CATALOG—An 8-page condensed catalog of refrigeration control valves is offered by Refrigerating Specialties Co., Chicago, Ill. The catalog contains capacity data and selection information for Freon and ammonia solenoid valves, back pressure regulators, evaporator controls, and condensing water regulators. ----------**Item 60**

PLASTIC PIPE BULLETIN — Bulletin 80-3 with information on Ryertex-Omicron polyvinyl chloride, rigid type, unplasticized pipe is issued by Joseph T. Ryerson & Son, Inc., Chicago, Ill. The bulletin lists over 200 chemicals the pipe will convey. ----------**Item 61**

HEATING CABLE GUIDE—A pocket-size cable spacing guide, for use by contractors in installing ceiling heating cable, is issued by Sunwarm, Inc., Kingsport, Tenn. The plastic guide gives the net square feet for any size room from 4 x 4 ft to 20 x 25 ft, and shows the correct spacing for radiant heating cable of wattages from 400 to 4400. ----------**Item 62**

AIR CLEANER DATA—Electronic air cleaners are described in a 12-page catalog (E-61), available from Trion, Inc., McKees Rocks, Pa. Engineering data, size and capacity tables and component parts description are given in the catalog for sizing and specifying. ----------**Item 63**

WATER COOLER BULLETIN—Literature, illustrating and describing the higher capacity remote-type water coolers is issued by Temprite Products Corp., Birmingham, Mich. ----------**Item 64**

DATA ON REFRIGERANTS—A technical wall chart giving pertinent physical and vapor pressure data for Genetron fluorinated hydro-carbon refrigerants is being distributed by General Chemical Div., Allied Chemical & Dye Corp., New York, N. Y., to refrigeration and air conditioning wholesalers and manufacturers, and to schools and colleges conducting refrigeration courses. The chart is intended to be used as an educational aid and reference source for data on the four major refrigerants used in air conditioning and refrigeration equipment. ----------**Item 65**

AIR CONDITIONING METHODS—A 12-page booklet with flow charts in colors is issued by A. I. McFarlan Co., Inc., New York, N. Y., covering its staged cycle and closed reversing cycle for air conditioning large buildings. Both methods are covered by patent applications. ----------**Item 66**

TEMPERATURE CONTROL—Bulletin No. 1025B, describing the LSI electric indicating temperature controller, has been revised by Sarco Co., Inc., New York, N. Y. A simplified operational sketch shows how the controller can be used to provide sequence control combinations such as: step-heating, heating and cooling, wide differential control, holding and operating temperatures, and the operation of signal devices. ----------**Item 67**

TUBING ALLOY DATA—Engineers and others involved with the design or maintenance of processing, equipment involving the use of tubular products at high temperatures are offered a technical release of The Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa. The folder, known as TDC-163A, furnishes information on analysis, mechanical and physical properties, and creep and rupture data on tubing alloys. ----------**Item 68**

AIR CONDITIONING DATA—Data sheets on air conditioners for remote cooling and heating systems are issued by Peerless of America, Inc., Chicago, Ill. Bulletin No. WB156 describes a ductless type unit, and Bulletin No. WBD156 describes a duct type unit. ----------**Item 69**

V-BELT BULLETIN—V-Belts are the subject of a bulletin (No. V-1400-B20-P) issued by Worthington Corp., Oil City, Pa. The bulletin contains numerous illustrations of the types of V-belts available for drives employed in heavy industrial applications and miscellaneous light machinery drives. ----------**Item 70**

LEAK DETECTION DATA—An 8-page bulletin (GEC-233F) on a refrigerant leak detector is offered by General Electric Co., Schenectady, N. Y. The bulletin describes features, applications, specifications, and operation of the portable instrument for locating leaks in closed systems. ----------**Item 71**

GAS HEATING CATALOG—A catalog, GN-56, covering a line of gas-fired commercial and industrial heating equipment, is published by Reznor Mfg. Co., Mercer, Pa. In addition to specifications, construction details and dimensional drawings and tables, the catalog also includes installation information. ----------**Item 72**

CONVECTOR CATALOG—A 23-page catalog of copper convectors (No. 327), is available from National-U. S. Radiator Corp., Johnstown, Pa. The catalog includes piping connections, capacity tables, roughing-in dimensions, and selection data for the convectors. ----------**Item 73**

SUBMERSIBLE MOTOR BROCHURE—A 12-page booklet illustrating the design and construction of water-lubricated submersible pump motors is available from Franklin Electric Co., Inc., Bluffton, Ind. Cutaway photos show all components in color, including details of hermetically sealed windings, 6-shoe thrust bearing, expansion diaphragm, filter-check valve, and control box. ----------**Item 74**

AIR CLEANER BOOKLET—A booklet (B-1425) describing the Precipitron electronic air cleaner for commercial and industrial applications is offered by Westinghouse Electric Corp., Sturtevant Div., Boston, Mass. Complete with pictures, drawings, and specifications, the booklet explains the cleaning of air by electrostatic precipitation and describes in detail the installation, operation, and maintenance of the units. ----------**Item 75**

WATER CHILLER CATALOG—An 8-page illustrated catalog (Bulletin 1426) describing the Tonrac single-stage hermetic centrifugal refrigerating machine is available from American Blower Corp., Detroit, Mich. The bulletin describes the features of the refrigerating machine and a cutaway photograph illustrates the various construction details. ----------**Item 76**

THERMOCOUPLE DATA BOOK—A 40-page bulletin, F-5228-3, discussing the construction and application of thermocouples and radiation detectors as used on industrial control applications is available from Barber-Colman Co., Wheelco Instruments Div., Rockford, Ill. Included is information on how to check, make, select, and size thermocouples. ----------**Item 77**

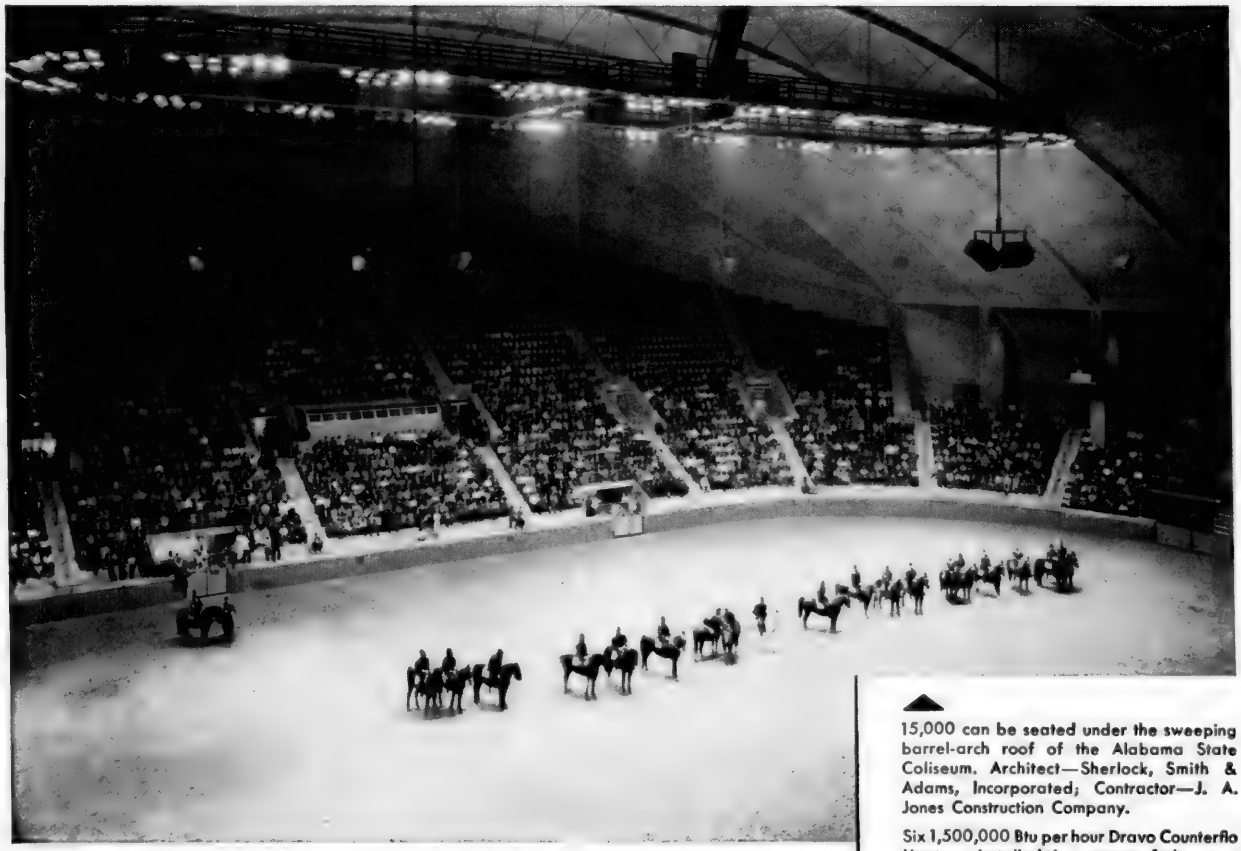
BRASS FITTINGS CATALOG—A catalog showing a line of brass fittings is issued by Span Brass Mfg. Co., Otsego, Mich. The catalog is subdivided for quick reference to kinds and types of fittings for the classifications of industry supplied by the company. ----------**Item 78**

PIPELINE EXPANSION DATA—A 24-page expansion joint design guide, Catalog No. 153, is released by Flexonics Corp., Maywood, Ill. The catalog is filled with engineering applications and selection data that is necessary to the proper solution of expansion problems. ----------**Item 79**

BRAZING BULLETIN—A bulletin (No. 72) on low temperature brazing is available from Handy & Harman, New York, N. Y. The bulletin contains news on the applications and developments of low temperature brazing. ----------**Item 80**

SUBMERSIBLE PUMP CATALOG—A catalog of a line of submersible pumps from 1/3 to 360 hp is offered by Lancaster Pump & Mfg. Co., Inc., Lancaster, Pa. Complete details and specifications on the line of pumps are given. ----------**Item 81**

(Continued on page 144)



15,000 can be seated under the sweeping barrel-arch roof of the Alabama State Coliseum. Architect—Sherlock, Smith & Adams, Incorporated; Contractor—J. A. Jones Construction Company.

Six 1,500,000 Btu per hour Dravo Counterflo Heaters, installed in groups of three on opposite sides of the arena, operate automatically to provide heat as needed. A seventh Dravo Counterflo, rated at 500,000 Btu per hour, heats the basement.

How Alabama solved unusual heating problems in its new Coliseum

Keeping the new Alabama State Coliseum at Montgomery comfortable posed many unusual problems for heating engineers. Size alone presented a big enough problem—the building is 10 stories high and almost the length of an average football stadium—but added were many special conditions.

When the building is empty heat loss amounts to 9,800,000 Btu per hr, but when filled, body heat sometimes raises temperatures enough that heat and humidity must be removed. The large open area also makes it difficult to provide uniform, easily controlled heat at all seating levels. Other rigid requirements include concealment of heaters to permit unobstructed visibility and quiet operation. With the aid of seven Dravo *Counterflo* Heaters the engineers solved all these problems.

Installed under the stands of the arena are six Dravo heaters that pull in fresh and return air in proportion to the Coliseum's needs. This air is quickly heated by the Dravo units and quietly distributed to all parts of the building. Functioning with the heaters is a sensitive temperature-humidity control system that operates the heaters or a series of exhaust fans, according to on-the-spot heat-ventilation requirements. The fully modulated *Counterflo* Heaters, with their stainless steel combustion chambers, are ideally suited for this precise job of providing instantaneous heat delivery when needed—or fresh tempered make-up air when ventilation is required.

Just as they've economically solved the unusual heating problems in this huge Coliseum, Dravo heaters can effectively meet your needs, large or small. For fast proof, use the coupon.

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NEWS OF THE MONTH

PURDUE STUDENTS

are honored by ASHAE branch. Awarded best books in field of air conditioning and heating.

Donald B. Doucette, a senior in the School of Mechanical Engineering at Purdue University was the recipient of the W. T. Miller Award for 1956. This award, named in honor of Professor W. T. Miller of Purdue, was established by the Indiana Chapter of the ASHAE to strengthen the Purdue student branch and to create a greater interest among students in the fields of heating and air conditioning.

Russell F. Puncochar (left), Donald B. Doucette, and Chester L. Piontek, Purdue University students, display books they received as W. T. Miller Award by ASHAE Indiana Chapter.

• **NAME ADDED TO PLAQUE**—The award consists of a permanent plaque to be hung in the Mechanical Engineering Building with the recipient's name to be added to the plaque each year. Mr. Doucette also received the best books in the field of air conditioning—a library of fifteen books valued at approximately $100.

Honorable mention was given to Russell F. Puncochar and Chester L. Piontek. Each of these students received several books valued at approximately $50.

The recipient of the award is selected by a committee of the Indiana Chapter based on the activity points of the student branch members. The committee interviews the three students with the highest numbers of activity points and selects the recipient of the Award.

ANTHRACITE PRODUCERS

deny rumors of shortages of small commercial sizes. Guarantee steam sizes. Say reserves are ample.

Architects, engineers, and large commercial consumers of small hard coal commercial sizes were specifically guaranteed delivery of ample supplies of fuel in a statement by the Anthracite Industry Council, released to dispel rumors of possible shortages in steam sizes for the coming winter.

Speaking for the council of major hard coal producing companies, Truman Dodson, vice president of Weston Dodson & Co., declared that some architects and engineers have personally expressed concern about recommending automatic anthracite commercial burning equipment because of the supply factor.

• **GUARANTEES DELIVERY.**—Major anthracite producing companies, Mr. Dodson, stated, will collectively guarantee the delivery of the small sizes of hard coal under contractual agreement. "Any reports of possibilities of shortages in anthracite supply are completely false and without foundation," he emphasized.

"In every instance we can assure delivery, because our large contract consumers are the ones who make it possible for us to calculate our work schedules and production quotas, and thus guarantee their own supply during the winter." Reserves of anthracite, Mr. Dodson pointed out, are also reassuring, with 175 years supply in eastern Pennsylvania.

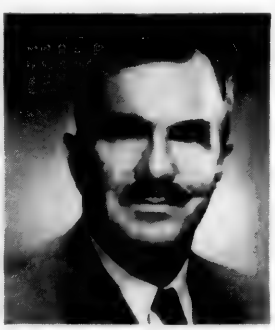
ASHLEY ELECTED PRESIDENT

of the ASRE at annual convention held in Cincinnati. Three technical sessions and inspection trips arranged.

Carlyle M. Ashley, chief staff engineer of Carrier Corp., Syracuse, N. Y., was installed as president of The American Society of Refrigerating Engineers at the fifty-second annual meeting of the society held at the Sheraton-Gibson Hotel, Cincinnati, Ohio, June 2 to 6.

The other officers are: Hermann F. Spoehrer, vice president and treasurer, Sporlan Valve Company, St. Louis, Mo., vice president; Cecil Boling, president, Bush Manufacturing Company, West Hartford, Conn., vice president; Daniel D. Wile, vice president, Refrigeration Engineering, Inc., Los Angeles, Calif, treasurer. The four new directors are Everett P. Palmatier, director of research, Carrier Corp.; John Engalitcheff, Jr., president, Baltimore Aircoil Company; Charles T. Hamilton, consulting engineer, Vancouver, B. C.; Robert G. Werden, New York sales manager, York Corp.

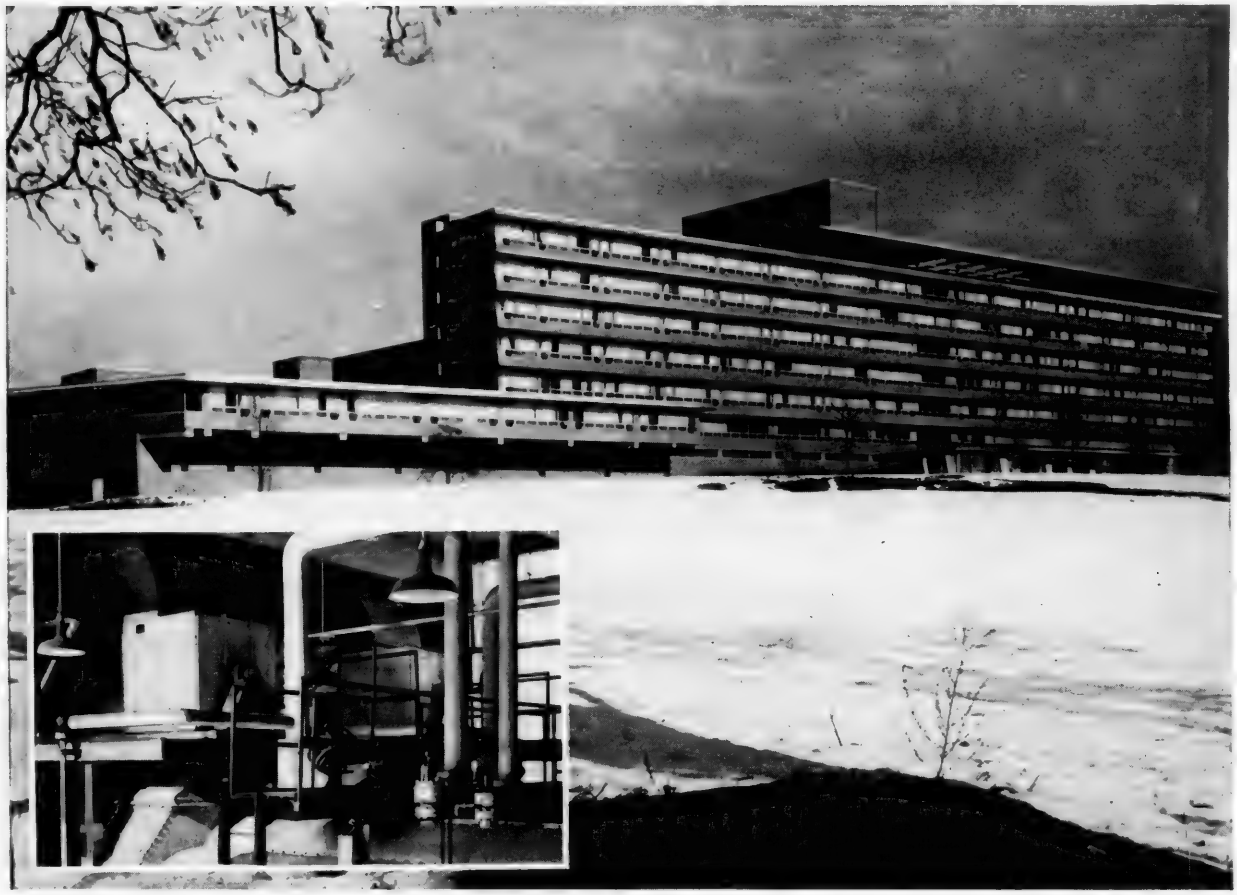
(*Continued on page* 130)



C. M. Ashley
President

H. F. Spoehrer
Vice President

Vincent G. Kling, Architect — A. Ernest D'Ambly, Mechanical Engineer — W. M. Anderson Company, Mechanical Contractors

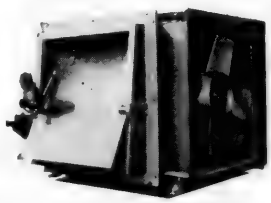


The Last Word in Modern Hospital Design Naturally Uses the Last Word in Mechanical Draft

THE LANKENAU HOSPITAL, in the suburbs of Philadelphia, is one of the world's most modern hospitals, both in architecture and equipment. The hospital itself was established in Philadelphia in the mid-nineteenth century, and has a distinguished history. It moved to its new building in 1953. In specifying equipment, its designers selected the most modern, the most efficient, the most scientific that could be found.

When it came to draft inducers for the boiler plant, they naturally selected Wing, which fulfill all those requirements, and in addition have back of them a lineage almost as old as Lankenau's own.

Wing Draft Inducers cut capital cost through elimination of high stacks, reduce maintenance costs, and result in sizeable fuel savings. They provide positive, adequate, uniform draft for boilers or furnaces entirely independent of weather conditions. And they save money through higher fuel-burning efficiencies. You should learn more about them. Write for Bulletin I-56.



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ASHLEY ELECTED PRESIDENT

(*Continued from page* 128)

Cecil Boling
Vice President

D. D. Wile
Treasurer

• **PAPERS.**—Robert F. Munier, consulting engineer for The Emerson Electric Manufacturing Company, St. Louis, Mo., presented a paper on Factors Considered in Hermetic Motor Design. Motors for hermetic compressors have variations from conventional motor design. Basic relationships among voltage, current and magnetic flux determine the proportions of the various sections of the magnetic structure and of the slot areas of the motors.

There is the need to carry sustained high overloads, the necessity of a low temperature rise rate under locked rotor conditions, the necessity of using more and thicker insulation pieces in the stator slots, the importance of high rotor inertia in some compressor designs, the requirements for a large diameter rotor counterbore and the need for large vent hold area through the rotor.

• **GALVANIC CORROSION.**—Ten ways to cut galvanic corrosion when use of dissimilar metals is unavoidable, were described by J. F. Mason, Jr., corrosion engineer, International Nickel Co., Inc., in his paper Use of Dissimilar Metals in Refrigeration and Air Conditioning Equipment.

Galvanic corrosion effect can be minimized in the use of dissimilar metals by selecting proper methods and materials. The speaker called attention to essential principles underlying the problem and the practical methods that have been adopted to prevent such corrosion. The most effective way for avoiding galvanic corrosion is to select materials which, when coupled, show no strong tendency to produce such action.

• **MOISTURE ANALYSIS.**—E. S. Taylor, service engineer, E. I. du Pont de Nemours & Co., Inc., described A New Instrument for the Moisture Analysis of Freon Fluorinated Hydrocarbons. The instrument provides an inexpensive portable electrolytic water analyzer which is as precise and accurate as any other method for moisture analysis of Freon-12. It operates continuously and automatically either in the plant on the process stream or elsewhere. He described the operational experience gained in the laboratory and in the plant.

• **COOLING TOWER CALCULATIONS.**—A paper on Crossflow Cooling Tower Calculations was presented by S. M. Zivi, head of the engineering analysis section, Midwest Research Institute, Kansas City, Mo. Co-author was Bruce B. Brand, chief engineer, Havens Cooling Towers, Division of Havens Structural Steel Co., Kansas City, Mo.

According to the authors the calculation procedure permits the comparison of test data on different designs, tested under similar but not identical ambient conditions, and it can be used to extend test data observed at several temperature levels to obtain tower performance over a very wide range of temperature and flow conditions. The procedure is particularly well suited for automatic computation but can also be done without a high speed computer.

• **DEIONIZATION OF WATER.**—A paper on Reduction of Total Solids by Deionization was prepared jointly by W. A. Cunningham, professor of chemistry, University of Texas and W. C. Mills, chemical engineer, Olin Mathieson Chemical Company, Brandenburg, Ky. The authors stated that deionization of water for ice manufacture is not a cure-all of universal application within its range of application, it has significant advantages which can be realized only when intelligent care and supervision are given to the operation of the equipment so that wastage of regenerants are held to a minimum.

Total treating costs for efficient deionization should be between 4 and 6 cents per 1,000 gal for each grain per gallon of dissolved solids removed. If raw water costs are high, it is important to hold wash water usage to a minimum by allowing rinse water to soak on the resin beds for several hours and by recycling a portion of the rinse water. Quality ice can be made without core removal but with air agitation from water containing at least 100 ppm total dissolved solids.

• **TEMPERATURE CHANGES IN ROOMS.**—J. L. Threlkeld, associate professor of mechanical engineering, University of Minnesota and Tamami Kusuda, research engineer, Worthington Corp., were joint authors of a paper on Temperature Changes in Refrigerated Rooms During Pulldown Period.

The authors demonstrated that by a simple graphical analysis, it is possible to show the relationship of condensing unit capacity, evaporator capacity and saturation suction temperature with respect to room air temperature during pulldown. An extension of this analysis may be used to predict the minimum space temperature which may be produced by a given refrigeration system.

The paper presents an extension to the existing knowledge of transient operating characteristics of refrigerations systems by discussing capacity characteristics of simple direct expansion systems, variation of capacity during pulldown period, and changes of wall and air temperature of a refrigerating room during a pulldown period.

• **TWO-STAGE HEAT PUMP.**—A two-stage heat pump that will work efficiently at low temperatures without the need for supplementary heating was described by Robert G. Werden, New York sales manager, York Corp., Philadelphia, Pa. The new development is available in either air-to-air or air-to-water systems and for commercial and industrial applications. This design does away with the need for electric strip heaters during very cold days.

• **AIR FLOW THROUGH CAPILLARY TUBES.**—F. G. Smith, assistant metallurgist (retired), The American Brass Company, Waterbury, Conn., spoke on Turbulent Flow of Air Through Capillary Tubes. An empirical formula

(*Continued on page* 132)

EXPANDED

CHICAGO'S

Enlarged Line of

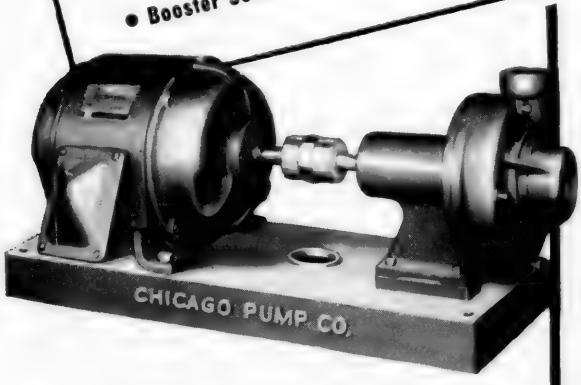
FC FLEXIBLE-COUPLED and CC CLOSE-COUPLED Pumps

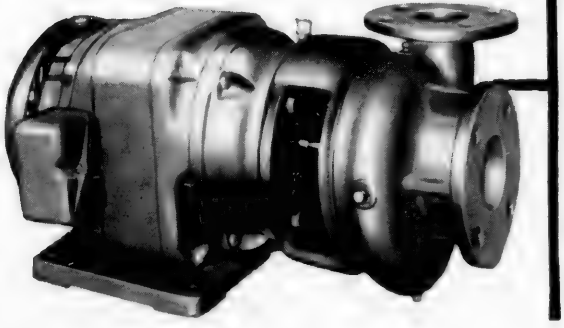
Gives You

More Choices, More Efficiency

Designed for:

- Water Supply Systems
- Cooling Tower Circulating
- Air Conditioning Systems
- Hot and Chilled Water Circulating
- Pneumatic Water Systems
- Booster Service

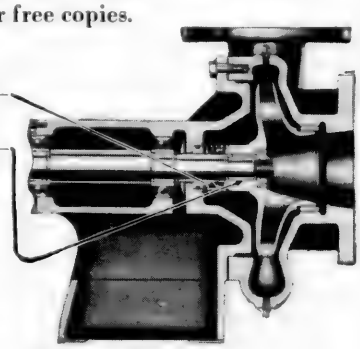




However specialized your need for a circulating pump, you are sure to find the model and size that exactly fits your requirements in Chicago's recently expanded centrifugal pump line. Now you can get high efficiency Chicago pumps in either close-coupled or flexible-coupled models with capacities from 5 to 400 G.P.M. and for heads from 10 to 190 feet. Complete line is described in two new bulletins, Nos. 107 and 108. Write to Dept. D for free copies.

FEATURING THE CERAMIC-FACED SEAL AND SHORT OVERHANG IMPELLER

All Chicago C-C and F-C pumps are equipped with the most reliable mechanical seal ever built into a pump! Ceramic-faced stationary seat is highly resistant to wear. Accurately lapped surfaces and automatic adjustment for wear assures long life under strenuous service. No troublesome packing replacement and maintenance, no shaft wear commonly found with stuffing box seals.



Silence Built-In

Ball bearings close to the end of the impeller insure ample support and alignment for quiet operation always. Impeller is perfectly balanced for vibrationless, noiseless rotation.

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Condo-Vac ®, Sure Return ®, AVC, LVC, Fire, House & Circulating Pumps, Pneumatic & Tankless Water Systems . . . Flush Kleen ® Sewage Ejectors, Little Giant ® & Non-Clog Bilge Pumps. Pumps for every industrial use.

ASHLEY ELECTED PRESIDENT

(*Continued from page* 130)

for air flow capacity in terms of inlet test pressure, inside diameter of tube and length of tube was developed. If pressure and flow requirements remain fixed, one can immediately find a most desirable combination of length and inside diameter to meet such requirements.

• **OTHER FEATURES.**—On Tuesday afternoon, one had the choice of inspection trips to Chevrolet-Norwood Division of GMC. The Fusite Corp.; Cincinnati Milling Machine Company; Concrete Testing of U. S. Army Engineers Corps Testing Laboratory.

In addition to the formal papers, there were conferences on air conditioning, frozen foods, and domestic refrigerator engineering, plus forums.

BURNING OF HEAVY OILS

discussed at symposium held as part of program of the 34th annual OHI convention in New York City.

Considerable interest was expressed in a commercial-industrial symposium on the handling and burning of heavy oils which was held at the Park Sheraton Hotel, New York City, on June 13, as part of the convention program of the Oil Heat Institute. About 300 persons attended.

Moderator of the meeting was C. H. Pesterfield, professor of mechanical engineering, Michigan State College. In discussing codes and ordinances he said that engineers and architects shoud be familiar with all codes governing the areas in which the engineers are operating.

• **HEAVY OILS.**—G. W. Bohn. Preferred Utilities, New York, in speaking on Handling and Burning Today's C-I Oils, pointed out that No. 6 oil today is much heavier than it has been in the past. It is safe to predict that future No. 6 oil will be heavier than that today, and therefore, we have to prepare for the burning of a heavier No. 6 oil. There is little probability that we will have as light an oil as we formerly had.

• **SPECIFICATIONS.**—Two members of the panel spoke on General and Specific Specifications for C-I Oil Burning Equipment.—Joseph Diehm of Voorhees, Walker Smith and Smith, New York City, and William Cleland of Seelye, Stevenson, Value and Knecht, New York City.

Mr. Cleland said that the best bids are obtained when there are good specifications. Experts should be called in to help out with specifications, when necessary. The specifications must be such as to insure that the owner will obtain conditions that he requires and they must be complete.

Mr. Diehm recommended that the engineer become well acquainted with the manufacturers' products so that he can properly advise his client what is available and what should be installed.

More and more plants are becoming interested in operating noises. Code regulations provide only the minimum of safety.

• **CONSTRUCTION SPECIFICATIONS.**—Kenneth M. Wilson, chief engineer, E. F. Klingler and Associates, Inc., Eau Claire, Wis., spoke on Construction Specifications and Their Relation to Professional Ethics. A modern building is an example of cooperative effort by many persons. With years to come, buildings will become more and more complex. On any design project, the final job is the writing of specifications. There should be little excuse for plans without proper specifications.

ARI HEAD

tells Institute convention that industry must police itself. Certification committee is to study programs.

In an inaugural statement at Hot Springs, Va., the newly elected president of the Air Conditioning and Refrigeration Institute, Matthew M. Lawler, declared that some companies in the industry are misleading the public with "extravagant claims, creating dissatisfied customers and so impeding progress."

He urged the industry to act on the problem because "any industry that cannot police itself from inside will eventually be policed from outside. . . ."

Mr. Lawler, vice president of Worthington Corporation's air conditioning and refrigeration division said, "something must be done to insure the integrity of manufacturers' ratings of equipment."

• **TO STUDY CERTIFICATIONS.**—The Institute appointed a committee to study certification programs used by other industries as one step toward combating the problem Mr. Lawler had outlined.

RESEARCH GRANT

is awarded to Carnegie Institute of Technology for air pollution studies. Will investigate aerosol charges.

The National Science Foundation has awarded $13,000 to Carnegie Institute of Technology for studies aimed at diminishing air pollution.

Principal investigator will be George Westinghouse Professor of Engineering, Gaylord W. Penney. Mr. Penney is the inventor of the Precipitron, an electrostatic precipitator which clears the air in ventilating systems.

• **WILL STUDY AEROSOLS.**—Under the National Science research grant, Mr. Penney will investigate electrostatic phenomena related to aerosols, which are suspensions of particles in air. In electrostatic precipitation, an electric field causes charged particles to precipitate out of the air. One of the first problems to be studied will be the measurement of electrical potential in a space filled with these charged particles.

The studies may prove useful in removing particles such as radioactive fallout from ventilating air, eliminating smoke, and combating dust explosions.

(*News continued on page* 134)

BISON

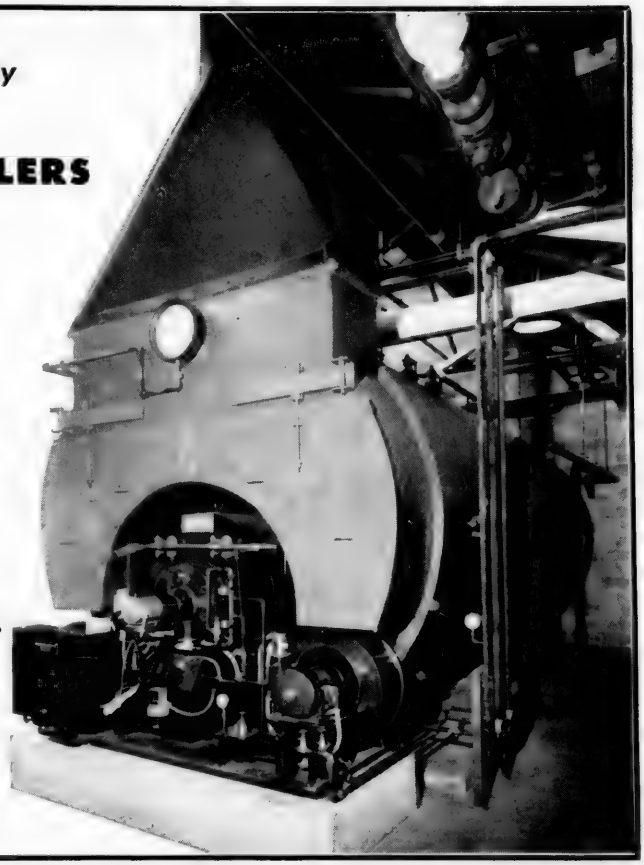
Dependable quality since 1863 . . . . .

POWER BOILERS

Throughout 93 years, Farrar & Trefts has been a leader in boiler design and construction. Today, as in yesteryear, F & T offers dependable, efficient, modern power boilers to satisfy the ever-increasing demands of institutional, apartment, office and industrial buildings. Under the same BISON brand, F & T also furnishes low-pressure boilers for heating purposes.

Proper selection of a boiler for the continuous delivery of required heat and power is a precise project, demanding the systematic approach of engineers long trained in this work. Engineers at F & T have this background of service and they welcome opportunities to evaluate the needs of boiler users.

Standard F & T Super Scot Power Boiler (150 lb. design pressure) with "Indiana Pack" burner at Mastic Asphalt Corp., South Bend, Ind. Furnished by Page Associates of Chicago. The Austin Co. were the Engineers and Contractors.



FARRAR & TREFTS DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

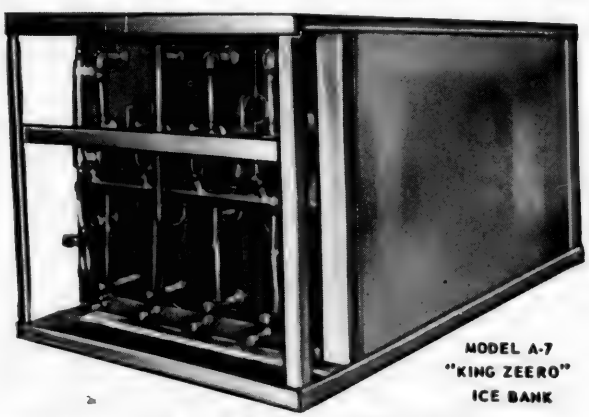
"King Zeero's" Sweet Water ICE BANKS offer ICE-CONCENTRATED Refrigeration for Air Conditioning

CONTINUOUS RIFLED GALVANIZED COILS
EXPANSION VALVE CONTROLLED

32°-34° COLD ICE WATER

DESIGNED FOR USE WITH:
FREON — METHYL CHLORIDE — AMMONIA

The "King Zeero" ICE BANK is designed for air cooling in Churches, Mortuaries, Theatres, Offices, Stores, Auditoriums, Factories, Clubs, Restaurants, etc. Ice Banks may be added to existing systems for increased capacity.



MODEL A-7
"KING ZEERO"
ICE BANK

The "King Zeero" ICE BANK is designed to deliver tons of 32 to 34 F. ice water for recirculation through air cooling coils. Peak loads many times compressor capacity are easily handled.

- DIRECTED COURSE OF WATER travels with "built-in" agitation.
- NO MECHANICAL AGITATION REQUIRED.
- LARGE WATER COMPARTMENTS spaced on 11" and 12" centers.
- 33% EXTRA ICE CAPACITY safely attained without freezing up.
- ICE IS "BURNED OFF" PLATE COILS progressively, exposing prime and secondary surface for maximum flash cooling capacity.
- ICE THICKNESS automatically controlled - eliminates "freeze ups."
- 94 SIZES to fit space requirements. Other designs for special applications.

CAPACITIES - 500 lbs. to 30,000 lbs. (72,000 B.T.U.'s to 4,320,000 B.T.U.'s) in a single unit. Multiple units may be installed.

MAIL COUPON TODAY

King Zeero Co., 4302 W. Montrose Ave., Chicago 41, Ill

☐ Please send me your new ICE BANK Catalog.

Name _____

Address _____

City _____ State _____

THE KING ZEERO COMPANY
4300-14 W. Montrose Ave., Chicago 41, Ill.

(*News continued from* page 132)

NDHA CONVENTION

held at Williamsburg, Va., June 4-7. Walter M. Gillespie of Consolidated Edison Co. is new president.

Over 200 members and guests attended the 47th annual meeting of the National District Heating Association that was held at The Inn and Lodge, Williamsburg, Va., June 4 to 7.

The new officers of the association are Walter M. Gillespie. Consolidated Edison Company of New York. Inc., president; John C. Haroldson, Duluth Steam Corp.. first vice president; William G. Gillim, Consolidated Edison Company of New York, Inc., second vice president; George F. Prestwich, Philadelphia Electric Co., third vice president; John F. Collins, Jr., secretary-treasurer.

• **STATISTICS COMMITTEE.**—Foster L. Stephens presented a report as chairman of the Statistics Committee. There was an increase in 1955 over 1954 in the total steam sold. This is accounted for by the increase in degree days, connected E.D.R. and space heated. However, there was a small decrease in the number of customers served and the number of billing meters. Possibly due to the reduced coal cost per Btu and increased sales per customer, there was a small decrease in the average gross revenue per M pounds of steam sold compared with 1954 figures. There was no appreciable change in annual load factor, steam losses and fuel handling costs.

• **NEW BUSINESS IN 1955.**—Sterling S. Sanford, Detroit Edison Company, presented a paper on New Business, Year 1955. It has data on new business obtained in 49 cities served by member companies. There were 510 new customers added in 39 cities and the estimated annual revenue is $3.172.491. The average revenue from all new business is $1.15 per 1,000 pounds. In 10 cities there were 44 customers who discontinued the service for some other method of heating and this loss in revenue was $252,838 per year. While the number of new customers is the lowest on record. the amount of steam sold and the revenue therefrom are higher than in any other year.

Additions to distribution systems are made in 21 cities in 1955 and 11 cities are planning additions to the system in 1956.

• **ECONOMIES WITH VALVATROLS.**—Results of a survey to determine economies effected by the Valvatrol control installed in several Rochester, N. Y. buildings were covered in a paper by Norman H. Davidson, Rochester Gas & Electric Corp.

Combined in one unit are the functions of both pressure regulator and motorized valve, thereby eliminating one valve and achieving a saving in space. Ability to adjust the opening time of the valve makes it possible to set the opening rate to suit the peculiarities of each individual piping system. By allowing the entire heating system to heat up almost in unison, there is much less thermal shock and unequal expansion in the piping.

Of the 12 installations in Rochester, only one has been in operation for more than one season. The other 11 have had less than one season operation and, therefore, there is not enough specific information on the economies realized.

• **SELLING STEAM TO INDUSTRY.**—Experience of The Detroit Edison Company in selling steam from an electric power plant to industry, was related in a paper prepared by Sterling S. Sanford of that company.

Experience in selling steam to industry from an electric power plant goes back to 1941. The Delray Power Plant is in an industrial area. 3.5 miles from downtown Detroit. Nearby industrial plants have been there for many years and their old boiler plants are in such condition, that many need replacement. Purchased steam service was attractive to nearby industrial users because the boilers were old and required replacement. and it was less costly to buy steam than to operate an old boiler plant.

• **WIDE RANGE METERING.**—A dual metering method has been used by The Detroit Edison Company on loads which are expected to vary over quite a wide range. The system consists of two flow meters, one or both of which are in use depending upon the load. An electrical control circuit automatically makes the necessary changes. The metering plan was described by V. J. Bliemeister.

Steam leaves the plant at about 400 psi and is reduced on the customers premises to pressures from 50 to 150 psi, depending upon individual requirements.

Capacities of the two flow meters are in the ratio of 4 to 1. The low range meter is equipped with two mercury switches, set to trip at 18 and 95% of full scale capacity. The high range meter has one mercury switch and it is set to trip at 16% of full scale capacity. These are nominal settings and they can be readily changed should the need arise.

A motor operated globe valve is equipped with a Limitorque control. This control is an electrically operated speed reducing mechanism with direct connecting driving motor and electrical and mechanical limiting devices for arresting the movement of the main gear through any predetermined travel or overload.

On low rates of flow, only the low range meter is in use. On loads greater than 95% of the capacity of the low range meter, the flow divides between the two meters and the division of flow is in the ratio of 4 to 1.

• **LINEAR FLOW ELEMENT.**—James W. Althouse, Jr.. Philadelphia Electric Company, presented a progress report on A Linear Flow Element. A field service test has been made of a steam metering installation which a linear primary metering element was used and compared with a duplicate installation using a conventional orifice as a primary metering element.

Investigators arrived at the following conclusions as the result of the field service test:

1. That the linear element can be made mechanically stable so that service conditions will not effect the calibration curve.

2. That entrained solids can be controlled by the use of a steam cleaner.

3. That entrained moisture and condensate can be controlled by proper design.

4. That the linear element will perform as well as an orifice for use as a primary metering element.

5. That improvements are possible in the design of a linear element and should be made prior to general appli-

(*Continued on page* 136)

FRICK

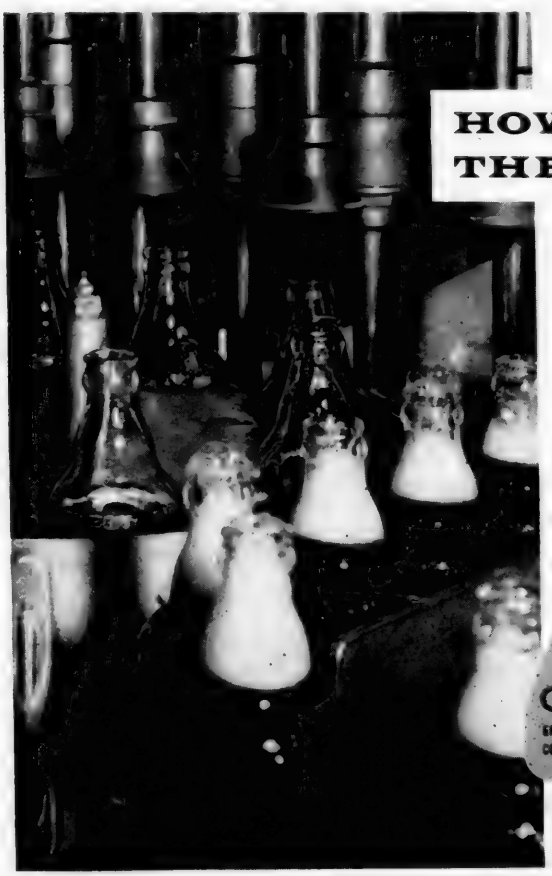
Unit Air Conditioners

Have built into them 50 years' experience in conditioning air, 74 years' experience in refrigeration, and 103 years of successful engineering. Frick unit air conditioners installed in 1938 are still in service — and good for a long time to come.

These superior units are furnished in sizes of 3, 5 and 7½ hp. They have heavier (quieter) cabinets, well insulated; larger cooling surfaces; insulated condensers; conservative ratings; and many other advantages. All are shown in Bulletin 522. Your copy is waiting: write today.

Some desirable territories still open for qualified Distributors.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.



HOW DOREX STOPPED THE TROUBLE A-BREWING

Scene: A famous Brewery. Neighboring plants include a copper mill, paint factory and paper mill — all contributing to a localized air pollution problem.

Problem: Beer flavor was being affected by polluted air. So much so that when the wind was in a certain direction, the brewery was forced to suspend operations — sometimes for days at a time.

Solution: Dorex Air Recovery was installed in the air conditioning system to purify air coming into the bottling room. This proved so successful that a second Dorex installation was made in the chilling room to prevent possible contamination at that point. *Dorex has completely eliminated shutdowns due to air pollution.*

If your operations require pure uncontaminated air, investigate Dorex Air Recovery. In addition to clearing up the immediate problem, Dorex can also substantially reduce costs of installing and operating an air conditioning and ventilating system. Write us for full information. Connor Engineering Corporation, Dept. B-76, Danbury, Connecticut.

CONNOR ENGINEERING CORPORATION

dorex® air recovery

MAKE MORE MONEY

4 WAYS WITH...

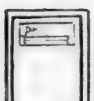
ALLENCO

Interior Fire Protection Equipment

Apart from reasonable material-costs, you can *count on* these advantages when you figure Allenco—

1. Prompt, accurate quotations from factory. No "extras".

2. Delivery as promised. No time-waste or costly check-back.



3. Quicker installation. Accurate dimensions, lower labor cost.

4. Each installation becomes a "testimonial," brings you other jobs.

AND, because the Allenco line is *complete*, you can figure it for *every* job in this field. See for yourself... call sales office in your city or write...

Since 1887

W. D. ALLEN MANUFACTURING CO.

Sales Offices in Principal Cities

ALLENCO BLDG., ROOM 710, 566 W. LAKE ST., CHICAGO 6

NDHA CONVENTION

(*Continued from page* 134)

cation of the device to metering problems.

Further study is necessary to develop the physical form of the element with emphasis on ease of calibration and maintenance; to improve the linearity of the calibration curve; comparison of very low flow rate performance with an equivalent orifice; extend the investigation of correction factor equations to additional pressure ranges, and a comparison of pulsating low performance with an equivalent orifice.

• **ATOMIC STEAM GENERATION.**—Clarence A. Dauber, The Cleveland Electric Illuminating Company, in his paper Economics of Atomic Steam Generation, gave cost comparisons between present methods of steam generation and estimated atomic reactor costs, based on best data available. Although there is a general impression that atomic energy will create a revolution, it is apparent that the change will be gradual and will be part of an evolution.

It will be many, many years before reactor steam generation will supplant use of fossil-fueled equipment. When it does, it will supplement rather than supersede the existing equipment. Furthermore, considerable reactor plant cost reduction is required before it will become economical. The electrical industry will bear most of the cost of this development.

The discovery of nuclear energy will help perpetuate the industry. It will provide an alternative fuel which will permit the continuous use of many of the existing facilities when carbonaceous fuels are too expensive to be competitive. In addition, it may assist in expanding the industry because small independent heating units may be less practical than now.

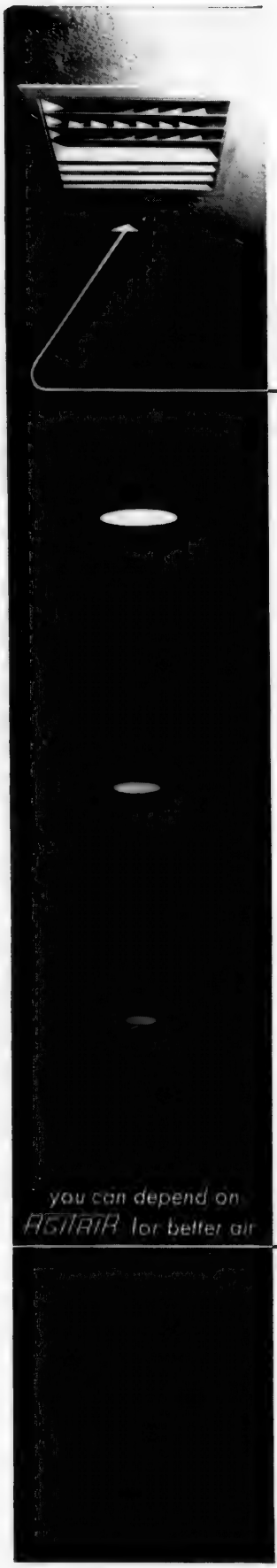
Larger capital outlays per customer will be required. This will necessitate better earnings than experienced at present. It would be well to proceed toward that objective now rather than postpone the day as immediate action will insure future financing. Inasmuch as the new method is in its extreme infancy, great improvements are probable.

Back Issues of the Guide Wanted for Students

Students in heating, ventilating and air conditioning courses find that even a back issue of the ASHAE *Guide* is a valuable reference book for school work.

Professor Frederick B. Morse of Purdue University writes that he needs additional Guides for prospective new members of the Student Branch this fall; so if any readers have a 1951 (or later) issue that is just collecting dust on their book shelves, why not let an engineering student have it?

Send your old *Guides* to: Frederick B. Morse, ASHAE Faculty Adviser, School of Mechanical Engineering, Purdue University, Lafayette, Indiana.



Custom Made

AIR DIFFUSERS with DIFFUSING VANES

Each AGITAIR square and rectangular air diffuser is custom designed to meet your requirements of air flow and interior treatment.

These AGITAIR diffusers have built-in diffusing vanes, scientifically arranged in unlimited louver patterns to provide certified 100% draftless air distribution from any ceiling or wall location.

AGITAIR Catalog R-107 shows you how to select the proper size and pattern for your job conditions.

Write for your copy today.

AIR DEVICES INC.
185 MADISON AVE., N. Y. 16, N. Y.
air diffusers • filters • exhausters

How to select the Right Water Cooler!
Bubbler Type?
Bottle Type?
Remote Type?
Condenser Cooled by Fan?
Condenser Cooled by Water?
Explosion-Proof?
How much water is needed by—
Office Workers?
Factory Workers?
Foundry Workers?
Cordley
All these and other pertinent questions on how to select the right water cooler are answered in this Folder.
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NEW YORK

Here's the New Guide
to water cooler selection

Just off the presses for immediate distribution is Cordley's easy four-step approach to the facts about water cooler selection. It eliminates all guesswork when purchasing water coolers. All the important questions are clearly and concisely answered for the man who specifies.

SOME COOLER QUERIES ANSWERED ARE:

Type required?
Kind needed for different conditions?
Capacity necessary?
Model most suitable?
How many coolers will satisfy?
Cooler location?

All these questions and others are objectively considered in our booklet "HOW TO SELECT A WATER COOLER"—guaranteed to save you plenty—yet costs you not a penny. SEND FOR IT TODAY.

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443 Fourth Avenue, New York 16, N. Y.
Since 1889... First in Water Coolers... Over 1,000,000 Sold

SAVE TIME and MONEY when you form

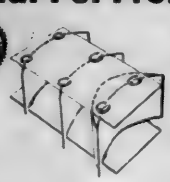
FLEXIBLE CONNECTORS

ELGEN SILENT DUCT

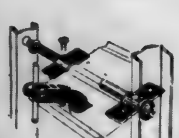
*Pats. Pend.

Imagine, this one-piece, factory-assembled metal-to-material unit unrolls absolutely *flat!* No more bothering with unwieldy duct material that buckles easily. Elgen Silent Duct makes on-the-spot work a cinch . . . you just measure and cut. You can fabricate *any type* of flexible duct connector in minutes . . . with half the effort! You can save up to 60%! No more worry about an inventory of "made-up" parts, either. Your choice of U.L. approved, (Gov't. Spec. Mil-D-10860) canvas, Johns-Manville asbestos and U. S. Rubber neoprene coated fibre glass, in 3" or 6" widths attached to 24 or 26 gauge galvanized steel or 24 gauge aluminum to fill every job requirement. All available in handy-to-use 25, 50 or 100 foot rolls.

2 More Elgen Products That Put Profits In Your Pocket!



ELGEN ALL-TITE VANE RUNNER
• Quickest and easiest way ever devised for installing turning vanes for square elbows • No special tools required; vanes lock easily with blow of hammer



ELGEN DAMPERSET
For Multi-Blade Dampers . . . Parallel or Opposed • Most perfect damper hardware developed • Assembles in a jiffy . . . cuts assembly time in half • Easily adjusted and self-aligning. Licensed by Minneapolis-Honeywell

ELGEN PRODUCTS ARE SOLD THROUGH LEADING JOBBERS EVERYWHERE.

"Put Profits In Your Pocket!"

Write today for free catalog and "spec" sheet!

ELGEN MANUFACTURING CORP. 41-34 39 Street, Long Island City, N. Y

HEATING PLANT CORROSION

(*Concluded from page 96*)

copper or copper alloy; galvanized steel has no advantage over black steel for condensate pipes because the zinc rapidly corrodes away (no protective scale).

Mr. Campbell said that external corrosion of copper pipes buried in insulating foamed concrete was infrequent, and could be explained by use of too much foaming agent. Ammonia produced from this attacked copper under stress at bends in the system. In the discussion, Mr. Carr did not agree; he considered the failures too common for such an explanation, and the question remains open. Comment on experiences in the U.S.A. regarding the corrosion (or the lack of it) of pipes buried in foamed concrete would be welcome.

Water and its Treatment

The final paper was a survey of methods of preventing scale and corrosion in boilers, by P. Hamer. He wrote from a background of experience with a large boiler plant and realized that much of the practice in that field would be inapplicable to small heating systems. He suggested that no water treatment at all might be safer than uncontrolled treatment. However, there were some lessons from large-scale practice which might be capable of being adopted with advantage on smaller plant, for example the use of sodium sulphite or sodium nitrite to protect plant standing idle for several days or weeks, and the value of eliminating free carbon dioxide as far as possible from any steam plant with condensate return. There has been negligible experience in Britain so far with the use of hydrazine for removing oxygen, with cyclohexylamine or morpholine for neutralizing CO_2 in condensate or with filming amines for protecting condensate lines. Hydrazine has, however, been tested in power station boilers and further tests are going to be made.

Mr. Campbell, in replying to the discussion, had no objection to grounding house electric wiring system via the water main. This could not cause internal corrosion and any external corrosion would be distributed over a large area of ground contact, even if the electrical system did develop a fault which sent a direct current to ground via the pipe.

WHAT READERS SAY

Artificial Ice Rink Costs

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING:

I wish to compliment W. G. Wassmandorf of The Trane Company, La Cross, Wis., for his article "Packaged Refrigeration Equipment for Artifical Ice Rinks" in the May issue of your magazine.

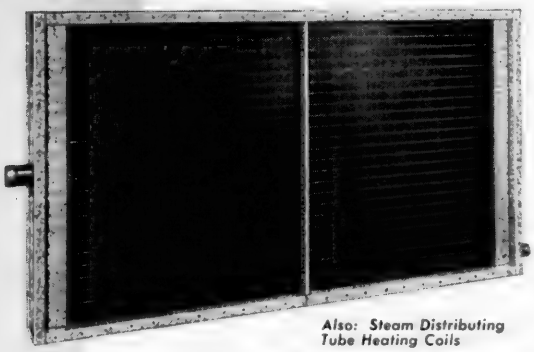
Among other very useful data he has supplied for the benefit of potential artificial ice rink owners, I find only one point of variance with actual fact—the cost of taking up and laying down the plastic floor pipe system that he terms a "roll-up" type rink.

Mr. Wassmandorf quotes an expenditure of around $1,000 each time the floor is taken up or relaid.

(*Concluded on page 140*)

RIGIDBILT

STANDARD STEAM HEATING COILS



Also: Steam Distributing Tube Heating Coils

MAXIMUM HEAT TRANSFER ASSURED!

All tube outlets from header are extruded, providing double thickness for tube insertions. Tubes are fabricated from 0.035" copper, nipple connections are brass, thus assuring strength for longer life with utmost economy.

RIGIDBILT IS BETTER BUILT — Write for Catalog

RIGIDBILT INC.

2852 WEST FULTON BLVD., CHICAGO 12, ILL.

HEATING • AIR CONDITIONING • REFRIGERATION

ELIMINATE

NOISY WATER HAMMER

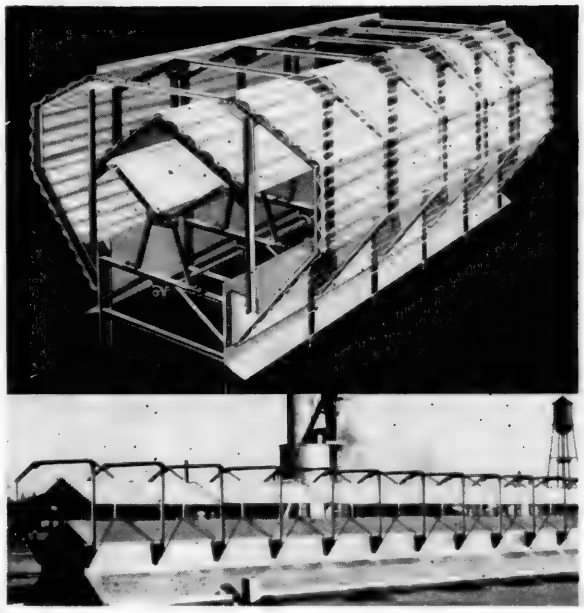
IN PIPE LINES

with

Josam **SHOCK ABSORBERS**

The sudden pounding of water hammer can be disturbing almost *any* time, *any* place on *any* plumbing supply line in hospitals, hotels, institutions, homes, business and industrial plants and other establishments. Water hammer is not only annoying . . . it causes untold damage to valves, fittings and pipe lines. Water hammer disappears when you install Josam Shock Absorbers . . . they assure "hospital quiet" on all piping systems. For complete information, write for Manual "S" on Shock Absorbers.

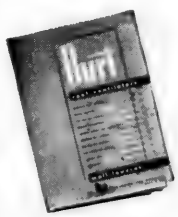
Josam **JOSAM MANUFACTURING COMPANY**
DEPT. HV MICHIGAN CITY, INDIANA



Burt Monovent on The S. K. Wellman Co. plant during erection by Industrial Roofing & Sheet Metal, Inc. Contractor—Albert M. Higley Co. Engineer—Vincent Eaton. Architect—Charles Bacon Rowley & Associates, Inc.

110 FOOT BURT MONOVENT EXHAUSTS HEAT AND SMOKE FROM THE S. K. WELLMAN CO. ADDITION

The S. K. Wellman Company's new 120' x 240' addition to their Bedford, Ohio plant required highly efficient ventilation to remove smoke and heat from metallurgical processing equipment. The solution—this 110' Burt Monovent Continuous Ridge Aluminum Ventilator, with 72" roof opening, quickly exhausts hot, stagnant air uniformly along the entire building. Center hinge butterfly type dampers and the fixed top form a cone-shaped airflow section that provides broad, simple air flow lines, eliminating numerous air passes and attendent friction losses. The Burt Monovent is economical to install, operate and maintain and highly efficient.



Send for FREE Data Book!

Write for Burt Data Book SPV-101-E. It supplies quick data on Burt's complete line of modern Roof Ventilators.

FAN & GRAVITY VENTILATORS
LOUVERS
SHEET METAL SPECIALTIES

The Burt Manufacturing Company
49 E. South St., Akron 11, Ohio
Member Power Fan Manufacturing Association

MERCURY-TO-MERCURY SWITCH
requires no service—contacts never pit, burn or corrode.
PERMANENT ALNICO MAGNET
links water level with electrical controls; prevents failure of mechanical linkages.
CORROSION-RESISTANT FLOAT
is made of 304 Stainless Steel for long, trouble-free service. Can also be made of special materials for extreme local conditions.
NO-SCALE FLOAT CHAMBER LINER
"flexes" off scale; prevents float "sticking".

Here's "Low Maintenance"

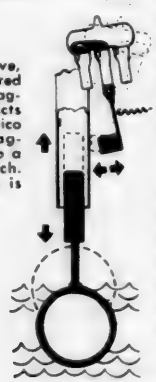
BOILER SAFETY

MAGNETROL

BOILER WATER LEVEL CONTROLS

"Blow-down" the float chamber once-a-shift; inspect the switches once a month—that's all you have to do to keep a Magnetrol in tip-top *safe shape.* It's made that way. The secret is all in the simple magnetic operating principle *as pioneered and perfected by Magnetrol.*

Standard Magnetrol Units are available for pressures to 600 psi and temperatures to 750°F., for single or multi-stage control with as many as three separate switching actions. Also special units for more extreme requirements. For full details, mail coupon.



A magnetic sleeve, raised and lowered within a nonmagnetic tube, attracts or repels an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

MAGNETROL, Inc.

MAGNETROL, INC., 2106 S. Marshall Blvd., Chicago 23, Ill.
Please send Catalog Section III with full information about Magnetrol Boiler Water Level Controls.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

(*Concluded from page* 138)

Mr. C. A. Meadows, as you are probably aware, was one of the first pioneers in this type of installation.

At one of four rinks recently completed in North York, Metropolitan Toronto, Canada, using Meadows Take-Up Type of plastic pipe floor and measuring 85 ft x 185 ft, the complete floor pipe system, including the removable wooden hockey dasher fence was completely removed and stored by 6 men in 5 days—cost $350. At this site, an underground culvert is used for storing the plastic pipe. This means at least two days' labor and this could be saved by the easier method of using a grade level trench with removable cover.

At the Hamilton Forum Arena in Hamilton, Ontario, the complete floor pipe system is again taken up and stored at a cost of "30 man-days"; in this instance, the pipe is hoisted up to the roof and stored on racks in the rafters. It is another installation in which considerable labor could be saved by the use of a convenient grade level trench for storage.

Re-installation of the floor pipe system takes about the same amount of time.

A. E. Hinton
Project Engineer, Artifical Ice Rinks,
Toronto, Ont. *C. A. Meadows & Associates, Ltd.*

Canadian Degree-Days for May, 1956*

City	May		Cumulative	
	1956	Normal	1955-56	Normal
Calgary, Alta.	411	480	10698	9111
Charlottetown, P. E. I.	668	536	8455	8263
Crescent Valley, B. C.	328	403	8072	7731
Edmonton, Alta.	296	428	11217	9797
Fort William, Ont.	658	567	10231	10045
Grande Prairie, Alta.	330	505	12133	10122
Halifax, N. S.	609	493	7346	7395
London, Ont.	422	307	7570	7275
Medicine Hat, Alta.	321	301	10049	8495
Moncton, N. B.	644	474	8747	8568
Montreal, P. Q.	464	325	8414	8413
North Bay, Ont.	643	434	9834	9180
Ottawa, Ont.	480	310	8734	8674
Penticton, B. C.	203	273	6912	6346
Prince George, B. C.	401	490	10772	8996
Quebec City, P. Q.	592	428	9160	9276
Regina, Sask.	406	434	11713	10891
St. John, N. B.	659	505	8520	8081
Saskatoon, Sask.	336	397	11896	10478
Timmins, Ont.	769	564	10983	10857
Toronto, Ont.	425	341	7056	7236
Vancouver, B. C.	255	326	5666	5303
Victoria, B. C.	315	366	5626	4935
Windsor, Ont.	338	251	6790	6705
Winnipeg, Man.	521	397	11423	10841

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

Manufactures' Representative

If you are seeking new lines, we suggest you register your name, territory covered, and present lines with this publication. We get numerous requests from manufacturers seeking representatives and by registering you pave the way to lining up desirable accounts. Write to the Research Director, AIR CONDITIONING, HEATING AND VENTILATING, 93 Worth St., New York 13, N. Y.

Air Capacities from 550 to 65,000 CFM Belt and Direct Drive

MODULAR

POWER ROOF VENTILATORS

- Our new and complete line of power roof ventilators with their advanced modern design and new construction features fulfill today's architectural styling and job performance requirements.
- With MODULAR construction the following important features have been accomplished — low profile, maximum strength, maximum net free areas, complete resilient mounting with no metal-to-metal contact between the top cap and body, power section and body, and body to curb base.
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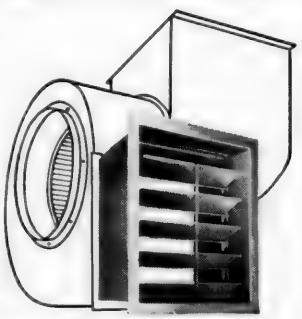
- Write for booklet that gives complete design, construction and performance data, and shows how to specify the correct Modular Roof Ventilator for maximum performance plus economy.

A few choice territories open for manufacturers' representatives

ATMOS CORPORATION
1215 W. Fullerton Ave.
Chicago 14, Ill.

ELGO AUTOMATIC SHUTTER
for Unit Blower



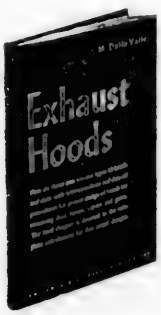
Self-contained in adapter sleeve for attachment to blower. Louvers of light gauge aluminum with felt silencer strips. Rustproof hinge rods. Weather-stripped. Built to fit your blowers.

Write for circular and prices

Free CATALOG

ELGO SHUTTER & MANUFACTURING CO.
2738 W. Warren Detroit 8, Mich.

EXHAUST HOODS



The only book published that gives comprehensive information on the flow of air around and into the openings, hoods or slots in exhaust ventilating systems. Covers all phases of hood, booth and slot design. Shows how to determine the required air volume and velocity for hoods and other types of openings for the control of all kinds of dusts, fumes and gases. Sample problems, with the solutions worked out in detail, are given in a chapter devoted entirely to this matter.

141 Pages, 127 Illustrations. 30 Tables. $3.50

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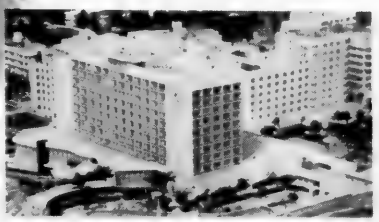
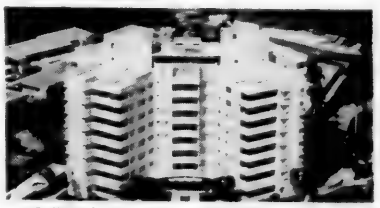


Seville Hotel, Miami Beach. Architect: Melvin Grossman/Air Conditioning Engineer: Sam L. Hamilton.

AND MORE

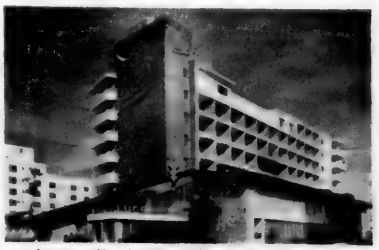
Hollywood Beach Hotel, Hollywood Fla. Architect: Melvin Grossman/Engineers: Sasnett Engineering.

AND MORE



Belle Isle Apartments, Miami Beach. Architect: Robert B. Swartburg/ Engineers: Altec Engineering Co.

AND MORE



Lucerne Hotel, Miami Beach. Architect: Carlos B. Schoeppl/Engineers: Altec Engineering Co.

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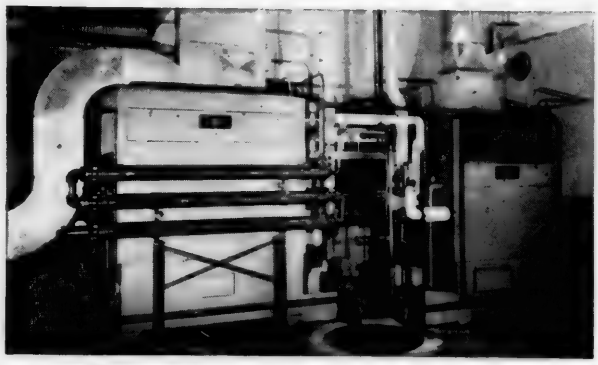

NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

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Sales Engineers in Principal Cities of U. S. and Canada

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

INSTRUMENT SOCIETY EXHIBIT—11th annual Instrument-Automation Conference and Exhibit (International), of the Instrument Society of America, at the new Coliseum building, New York, N. Y. J. McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 13, Pa. . . . . **SEPTEMBER 17-21, 1956.**

ELECTRONICS CONFERENCE—12th annual National Electronics Conference and Exhibition at the Hotel Sherman, Chicago, Ill. Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill. . . . . **OCTOBER 1-3, 1956.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Auditorium, Atlantic City, N. J. Secretary of the Association, 420 Lexington Ave., New York 17, N. Y. . . . . **OCTOBER 15-17, 1956.**

ASA MEETING—38th annual meeting of the American Standards Association, in conjunction with the Seventh National Conference on Standards, at Hotel Roosevelt, New York, N. Y. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. . . . . **OCTOBER 22-24, 1956.**

REFRIGERATION ENGINEERS CONVENTION—Annual convention of the Refrigeration Service Engineers Society, at Hotel Muehlbach, Kansas City, Mo. H. T. McDermott, International secretary of the Society, 433 No. Waller Ave., Chicago, Ill. . . . . **NOVEMBER 15-18, 1956.**

ASRE CONVENTION—Semi-annual meeting of the American Society of Refrigerating Engineers, at Hotel Statler, Boston, Mass. Secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **NOVEMBER 25-28, 1956.**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, Hotel Statler, New York, N. Y. Secretary of the Society, 29 W. 39th St., New York, N. Y. . . . . **NOVEMBER 25-30, 1956.**

POWER SHOW—The 22nd National Exposition of Power and Mechanical Engineering, under the auspices of the ASME, at the New York Coliseum, Columbus Circle, New York, N. Y. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **NOVEMBER 26-30, 1956.**

CHEMICAL EXPOSITION—9th National Chemical Exposition of the American Chemical Society, in the Cleveland Public Auditorium, Cleveland, Ohio. Secretary of the Chicago Section of the Society, 86 E. Randolph St., Chicago, Ill. . . . . **NOVEMBER 27-30, 1956.**

WARM AIR HEATING CONVENTION—Annual convention and committee meetings of the National Warm Air Heating and Air Conditioning Association, at the Netherland Plaza Hotel, Cincinnati, Ohio. George Boeddener, managing director of the Association, 145 Public Square, Cleveland 14, Ohio. . . . . **NOVEMBER 27-30, 1956.**

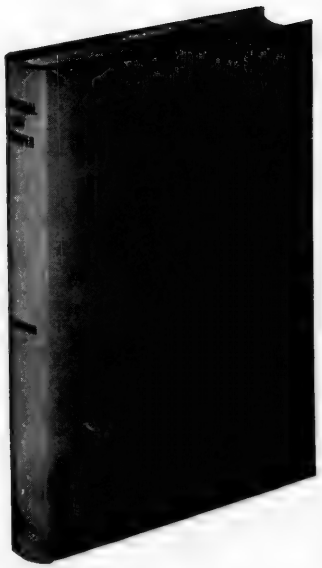
ASHAE EXPOSITION—International Heating & Air-Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. Exposition held in conjunction with the 63rd annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **FEBRUARY 25-MARCH 1, 1957.**

METALS CONGRESS AND EXPOSITION—10th Western Metal Congress and Exposition, sponsored by the American Society for Metals, and other technical groups, at the Pan-Pacific Auditorium and the Ambassador Hotel, Los Angeles, Calif. W. H. Eisenman, managing director of the Society, 7301 Euclid Ave., Cleveland 3, Ohio. . . . . **MARCH 25-29, 1957.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. . . . . **APRIL 8-10, 1957.**

REFRIGERATION INSTITUTE MEETING—Annual meeting of the Air-Conditioning and Refrigeration Institute, at The Homestead, Hot Springs, Va. Executive secretary of the Institute, 1346 Connecticut Ave., N. W., Washington, D. C. . . . . **MAY 6-8, 1957.**

TESTING MATERIALS MEETING—60th annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 16-21, 1957.**



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Binks cooling towers cut water bill 75%

As producers of aluminum, tin and lead foil, Johnston Foil uses water ...and lot's of it...to cool the foil mill and drying rolls. Before installing Binks cooling towers, city water was used on a one-pass basis. Now water is recycled and the heat dissipated by two, triple-blower Type-B cooling towers. Only make-up water is required.

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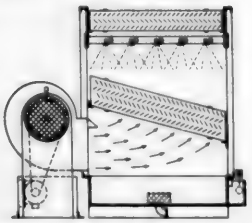
High Efficiency. Binks patented Roto-jet spray nozzles plus internal redwood nailless decking assure thorough water breakup. Scientifically balanced air-to-water ratio gives high cooling efficiency under all climatic conditions.



Cross-section showing counter-flow air-water movement employed in Binks Series 3-B towers.

Minimum maintenance. Blowers and motors are outside the tower—not in the moisture-laden air stream. All panels are heavily galvanized. Outsides of towers have two coats of aluminum paint—insides, a tough, durable zinc chromate coating.

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NEW CATALOGS

(Continued from page 126)

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

REFRIGERATION CATALOG—A 32-page catalog (No. 56) of coils for commercial refrigeration is published by Peerless of America, Inc., Chicago, Ill. In addition to listing and illustrating the various coils the catalog gives dimensional and engineering information. ----- **Item 82**

PUMP BULLETIN—Single and duplex condensation pumps are described in Bulletin S200 available from Domestic Pump & Mfg. Corp., Shippensburg, Pa. Engineering data, roughing-in dimensions, and suggested specifications for the pumps are given in the bulletin. ----- **Item 83**

STORAGE TANK HEATING—A 4-page bulletin (ATH 55) which describes storage tank heating coils for heating storage tank water with live or exhaust steam or with circulating boiler water is issued by Alstrom Corp., New York, N. Y. A conversion factor table and a rating and dimension chart are in the bulletin which help one to choose the correct size heating coil required. ----- **Item 84**

LIQUID CHILLER BROCHURE—A brochure (Form ACC-179) is available that describes and contains capacity data on more than thirty different models of packaged liquid chillers manufactured by Airtemp Construction Corp., Dayton, Ohio. ----- **Item 85**

EXCHANGER DOOR BULLETIN—An illustrated 4-page bulletin (No. 2030), describing the p-k Lever-Lock quick opening door for heat exchangers, sterilizers and autoclaves, is offered by Patterson-Kelley Co., Inc., East Stroudsburg, Pa. Five large photos show the p-k Lever-Lock door in use on horizontal and vertical equipment, with both manual and pneumatic control. ----- **Item 86**

PLASTIC PIPE ARTICLE—A bi-monthly external wage house organ, the Plastics Weldor and Fabricator with a feature article on the use of polethylene pipe for industrial waste and sewage lines is available from American Agile Corp., Maple Heights, Ohio. The article contains photographs illustrating the joining of pipe sections into proper length and the subsequent installation steps. ----- **Item 87**

VARIABLE DRIVE BOOKLET—A 44-page booklet (20P50) with tables for the selection of variable speed Texrope drives is released by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The booklet includes information on design features, drive principles, horsepower rating tables for A, B, C, D, and E section belts, a speed range table showing the variation in rpm when using two sheaves in combination, and accessory equipment. ----- **Item 88**

(Continued on page 146)

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Would you like to save time? Get accurate information? A few minutes invested now may save you hours on your next job. You'll find your questions answered quickly, simply and correctly in these valuable books. Choose the ones you need and mail the coupon now. You'll be glad you did.

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Includes 96 full-page charts to solve your problems of heating and ventilating involving load determination, duct design, panel heating, solar heating and combustion analysis. Opposite each chart is a design example and the solution illustrating the use of each method. The text clearly explains the engineering background and the mathematical basis of each chart.

320 Pages, 96 Charts, $7.00.
In Canada or overseas, $7.80.

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS

How to design, build or buy an exhaust system that will function adequately and economically, and meet the requirements of law and industrial hygiene. Covers flow of fluids—hood forms—air flow through hoods—pipe resistance—piping design—dust separators—low pressure conveyors—centrifugal exhaust fans—structural details—field measurements and their interpretation.

252 Pages, 122 Illustrations, $3.50.
In Canada or overseas, $4.25.

EXHAUST HOODS

Practical hood design, including the latest principles of air handling, contaminant dilution and transport velocities. Includes design of hoods for control of dust, mist, fumes, vapors and gases with many particular references to processes such as bagging, drilling, screening, grinding, welding, plating and many others. Simple formulas and diagrams show exact procedures.

130 Pages, 127 Illustrations, $3.50.
In Canada or overseas, $4.20.

FLOW AND FAN

The *flow* of gas through ducts, and *fan* performance and control are authoritatively covered in this useful work. Covers principles of moving air through ducts, including elements of fan selection and control, duct arrangement, system characteristics and flow analysis. Gives basic data and describes methods used to calculate system resistance, plus practical information that will help in selecting a fan for a given duty.

232 Pages, 84 Illustrations, $4.00.
In Canada or overseas, $4.70.

FLUID FLOW IN PIPES

How to solve problems involving the flow of liquids and gases through pipes. Shows how to handle viscosity, friction, head, and other factors expressed in various dimensional systems. Applications of the principles to problems in piping are presented with worked-out examples.

124 Pages, 18 Illustrations, $3.00.
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FUEL OIL MANUAL

Covers characteristics and uses of every type and grade of fuel oil. Explains the meaning of each oil property, and shows how this information is applied in selecting, handling and burning fuel oil. A special chapter covers fuel oil additives and how they are used, and another covers troubles encountered in using fuel oil and shows correct remedies.

160 Pages, 34 Tables, $3.50.
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INDUSTRIAL HEAT TRANSFER

A combined text and reference book that provides 123 time-saving working graphs for the direct solution of most commonly encountered problems. Use of these graphs, which are equal in accuracy to the equations from which they are derived, helps to eliminate errors in calculation.

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METHODS OF JOINING PIPE

In no other book will you find so much detailed information on standard and special joints for all types of metallic, glass, tile, plastic and concrete pipe. Also included are data on joints designed to take up movement due to expansion and contraction. Written by a mechanical engineer with many years' experience.

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Original tables, based on practical experience, which enable pipefitters to solve problems of pipe bending, mitering, layout, threading, etc., either in the shop or in the field. Convenient pocket size, flexible Fabrikoid binding.

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Contains design factors and data that can be applied to any situation. Principles are clearly set forth and lead logically to rules of procedure. By the simple observation of a process you can now estimate accurately the exhaust requirements of any cold, multi-directional process; and, with the necessary field data, refer to tables which summarize exhaust requirements for such a situation.

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The basic principles, the experience-proved facts, the practical working data on applications of radiant energy for heating and cooling. Facts and figures can be applied directly in designing and installing radiant heating systems. Easy-to-use charts give most of the design data without calculation.

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- **FEATURES:** Automatic Electric Ignition. Electronic Safety controls-positive automatic shut-off if flame or power go out. Patented Firing Head — prevents flame-outs and pulsation. Larger models have two stage firing and prepurge and post purge programming.

Manufacturers of U.L. Approved Gas Burners, Oil Burners and Dual-Fuel Burners ranging in capacity from 1 to 100 BHP. 100,000 to 4,600,000 BTU/hr.

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DUAL GAS OIL syncro flame BURNER

NEW CATALOGS

(Continued from page 144)

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

SCHOOL HEATING BOOKLET—A 12-page sales booklet (Bulletin No. 2181) on the Vari-Air system of heating, ventilating, and cooling schools and public buildings is published by C. A. Dunham Co., Chicago, Ill. The bulletin contains selection, capacity and dimensional data, typical installations and applications as well as material on the operation and features of the system. ----------**Item 89**

SEWAGE PUMP BULLETIN—Bulletin 121-A describing a line of pumps for handling solids in suspension is issued by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill. Along with descriptions of the pumps are proposed specifications for the use of architects and engineers. ----------**Item 90**

SAFETY VALVE BULLETIN—A 6-page bulletin (4000-1515) on its safety cleanout valve for use on buried storage tank installations of volatile, inflammable liquids is available from Petrometer Corp. (formerly Liquidepth Indicators, Inc.), Long Island City, N. Y. The bulletin describes in detail the construction and operation features of the valve. ----------**Item 91**

INSTALLATION MANUAL—Eighteen different ways to install self-contained, central system air conditioners are described in a manual published by Amana Refrigeration, Inc., Amana, Iowa. The 24-page manual uses drawings and diagrams, with brief text descriptions, to present the installation data. ----------**Item 92**

PIPE CUTTING BULLETIN—An abrasive pipe cutoff bulletin has been revised by Beaver Pipe Tools, Inc., Warren, Ohio. The bulletin gives specifications, descriptions, cutting times and other features concerning the line of abrasive pipe cutting machines. ----------**Item 93**

VIBRATION MOUNT CATALOG—A line of rubber-in-shear vibration mountings is described in a catalog (No. RS-55) released by T. R. Finn & Co., Inc., Hawthorne, N. J. Various types of vibration mountings, with load capacities ranging from 40 to 10,000 pounds, are described as are the non-walking base-plates. ----------**Item 94**

MANOMETER GUIDE—A bulletin (No. G-10) intended as a reference guide to manometer-type instruments is issued by The Meriam Instrument Co., Cleveland, Ohio. The bulletin sets forth the four basic types of manometers ranging from the simple U-tube to the ultra-precision models and provides principles to aid in the proper selection. ----------**Item 95**

BOILER DATA—Specifications, ratings, and engineering data of a gas-fired boiler for large heating requirements are given in a bulletin issued by National-U. S. Radiator Corp., Johnstown, Pa. The data is given for all types of gas fuels, in addition to dimensional data and control diagrams. ----------**Item 96**

COOLER SPECIFICATIONS—A specification sheet (Bulletin No. C1100-S109P) giving features, dimensions, weights, sizes, and component parts of 3, 5, and 7½ hp packaged air conditioners is issued by Worthington Corp., Harrison, N. J. ----------**Item 97**

DEFROST MANUAL—A 16-page manual (No. TV-320), covering operation, application, and specifications of the new L Thermobank automatic hot gas defrost system, is released by Kramer Trenton Co., Trenton, N. J. The manual contains engineering data for temperature applications from plus 32 to minus 75 deg F with ratings at various levels. In addition, there are selection tables covering the range of box sizes at various temperature levels. ----------**Item 98**

INSULATION BLOWER BULLETIN—An insulation blowing machine is described in a 4-page illustrated bulletin issued by Universal Insulating Machine Co., Van Wert, Ohio. Included in the bulletin are pictures of the machine, operating data, model specifications and details of its features. ----------**Item 99**

PUMP MOTOR BROCHURE—Illustrations and technical drawings depicting features and applications of various types of vertical turbine pump motors are given in a brochure (No. 1903) distributed by U. S. Electrical Motors Inc., Los Angeles, Calif. It describes hollow shaft Verticlosed grease-and oil-lubricated motors in sizes from 1½ to 400 hp; also single phase designs up to 7½ hp, and totally-enclosed types up to 150 hp. ----------**Item 100**

FITTING AND FLANGE DATA—A folder describing wrought iron welding fittings and flanges is published by Tube Turns, Louisville, Ky. The folder gives dimensional data on the company's products in sizes from ½ to 12 in., discusses the physical properties of the material, and illustrates applications. ----------**Item 101**

GAS CONTROL BULLETINS—Two separate 6-page bulletins are released by A-P Controls Div., Controls Corporation of America, Milwaukee, Wis., covering its new Fifty-Five gas control. Bulletin G170 has information and data of interest to design and production engineers. Bulletin G170A is tailored to the interests of sales managers, distributors, and dealers. ----------**Item 102**

WROUGHT IRON BOOKLET—A 16-page booklet on wrought iron pipe for modern buildings is available from A. M. Byers Co., Pittsburgh, Pa. Thirty-six pictures and sketches are used in the booklet to illustrate wrought iron pipe applications in modern building. ----------**Item 103**

OIL HEATING CATALOG—The steam and water ratings of an oil-fired, cast-iron boiler-burner unit are given in a bulletin published by National-U. S. Radiator Corp., Johnstown, Pa. Dimensions and tapping sizes for the unit are given in addition to the ratings. ----------**Item 104**

STEAM TRAP BULLETIN—Bulletin 301, describing a line of steam traps for low, medium, and high pressure steam and for compressed air service is issued by Illinois Engineering Co., Chicago, Ill. The bulletin gives the dimensions, maximum capacities, and cutaway drawings and illustrations of the traps. ----------**Item 105**

MOTOR CATALOG—A catalog containing information on a line of fractional horsepower electric motors, as well as on MonoMotors, blowers, and special products is offered by Redmond Co., Inc., Owosso, Mich. Included in the 12-page catalog are photographs, diagrams, and performance data. ----------**Item 106**

PACKING BULLETIN—An 8-page bulletin on packings and gaskets made of Teflon is issued by Packing Div., Raybestos-Manhattan, Inc., Passaic, N. J. Service recommendations for each type packing is included as well as sizes in which they are available. ----------**Item 107**

PORTABLE TOOLS CATALOG—Portable tools for the plumbing, heating, and sheet metal industries are illustrated in catalog No. PC-501, published by Price & Rutzebeck, Hayward, Calif. Featured in the literature are the company's Planetor boring bits and special plumber-and-fitter sets. ----------**Item 108**

CONDENSER CATALOG—A 12-page catalog on the MC line of heavy duty evaporative condensers is issued by Baltimore Aircoil Co., Inc., Baltimore, Md. The catalog covers the twenty-two sizes, from 10 to 350 tons, for Freon 12, Freon 22, and ammonia. Selection data and dimensional drawings are also included. ----------**Item 109**

SINGLE-STAGE PUMP BULLETIN—A pump bulletin, Form 7248-A, covering the line of DMV-DHV single-stage centrifugal pumps is available from Ingersoll-Rand Co., Phillipsburg, N. J. The bulletin includes typical installation views, cross sectional views, and exploded views of component parts. ----------**Item 110**

BOOK ON COOLING SYSTEM—A 24-page book (No. 5922) on an incremental system of air conditioning for office buildings and other multi-room structures is announced by Remington Air Conditioning Div., Remington Corp., Auburn, N. Y. The book is divided into six sections covering a general description of the system. The technical section includes specifications for various types and sizes of convectors. ----------**Item 111**

COOLING TOWER BULLETINS—Two bulletins giving the specifications of natural and forced draft cooling towers are issued by J. F. Shelton Co., Memphis, Tenn. Bulletin No. 3-6591 gives the data for natural draft towers, and Bulletin No. 2-6591 contains the data on spray type forced draft towers. ----------**Item 112**

STEAM SPECIALTY CATALOG—A 32-page catalog (No. 68J) of steam specialties is published by Strong, Carlisle & Hammond Co., Cleveland, Ohio. The catalog lists the specifications of traps, strainers, valves, and separators for low, medium, and high pressure services. ----------**Item 113**

UNIT HEATER BULLETIN—The specifications and performance data for Herman Nelson horizontal and vertical unit heaters have been written into a 36-page product bulletin (No. 700A) by American Air Filter Co., Inc., Louisville, Ky. The bulletin includes hot water and steam performance tables, dimensions, selections, applications, descriptions of cabinets, elements, motor mountings, fans and accessories, controls, suggested layouts, and piping diagrams. ----------**Item 114**

CATALOG OF TESTING DEVICES—Eighty different devices are covered in a 40-page testing instruments reference book published by General Electric Co., Schenectady, N. Y. Titled the Measurement Equipment Catalog, GEC-1016, the publication contains product information including applications and sources of additional information. ----------**Item 115**

SOLENOID VALVE CATALOG—Catalog No. 200 from Atkomatic Valve Co., Inc., Indianapolis, Ind., describes the company's line of electrically operated two-way solenoid valves for air, gas, steam, and liquid flow control. The catalog lists available dimensions, specifications, pressures and applications of solenoid valves in bronze and stainless steel. ----------**Item 116**

SUBMERSIBLE PUMP BULLETIN—A 12-page bulletin describing a line of submersible pumps is released by Byron Jackson Div., Borg-Warner Corp., Los Angeles, Calif. A selection chart is provided, giving capacity and head performance of the pumps. ----------**Item 117**

TECHNICAL PIPING FOLDER—Engineers and others associated with the design or maintenance of processing equipment and piping are offered an 8-page technical folder (TB-410) by Tubular Products Div., The Babcock & Wilcox Co., Beaver Falls, Pa. The folder contains application data on seamless and welded stainless steel pipe and welding fittings and furnishes helpful hints on the bending, joining, and welding of these products. ----------**Item 118**

BOILER WATER CONTROL—A 4-page bulletin (No. 5623) suggesting a solution to out-of-bounds initial, operating, and maintenance cost of boiler water level control is offered by The C. E. Squires Co., Cleveland, Ohio. The bulletin describes a control that is applicable on new boiler plants or where the replacing of existing steam generating equipment is necessary. ----------**Item 119**

HEATER BROCHURE—A brochure and literature describing Champion direct-fired heaters is issued by National Heater Co., St. Paul, Minn. Information on six different models is contained in the brochure. ----------**Item 120**

FIBER PIPE USES—An 8-page brochure, containing information on the uses and the processes for manufacturing bituminized fiber pipe and couplings, is published by The Central Foundry Co., Newark, N. J. The booklet explains how fiber pipe can be used in house-to-sewer, septic tank, foundation drainage, industrial, and other installations. ----------**Item 121**

BASEBOARD INSTALLATION—An installation manual for a cast iron baseboard, for steam or hot water, is issued by National-U. S. Radiator Corp., Johnstown, Pa. Installation instructions, roughing-in dimensions, ratings, and accessory details are given in the manual. **Item 122**

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

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for efficient, low cost
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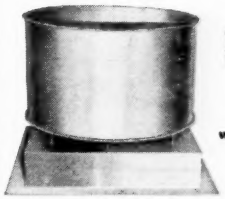

model 53

the new "low-level" design

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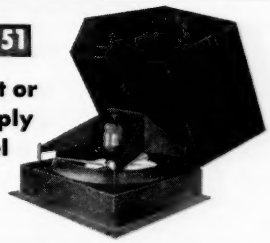
model 51

exhaust or air supply model



Forces out stale, stagnant air or pulls in fresh, clean air. Serves as gravity ventilator when fan is not in operation. Conforms to modern plant design. Sizes 24" to 48". Capacities to 26,450 CFM.

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Heavy-duty galvanized steel, with automatic dampers, for greater resistance to weather and corrosive atmospheres. Bolted construction increases strength; simplifies servicing. Sizes 12" to 72" for capacities to 80,000 CFM.

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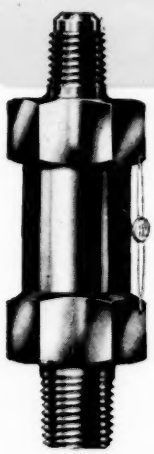

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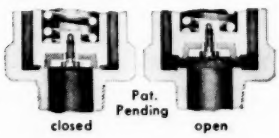

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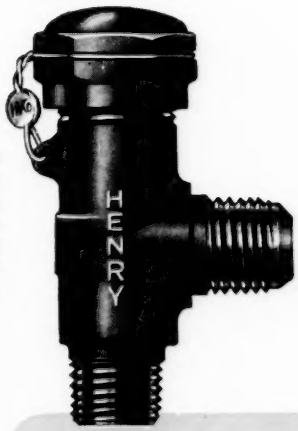

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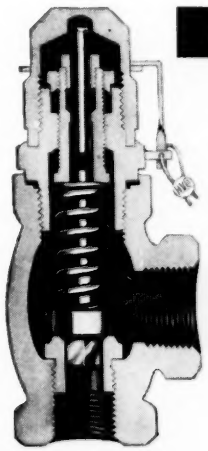

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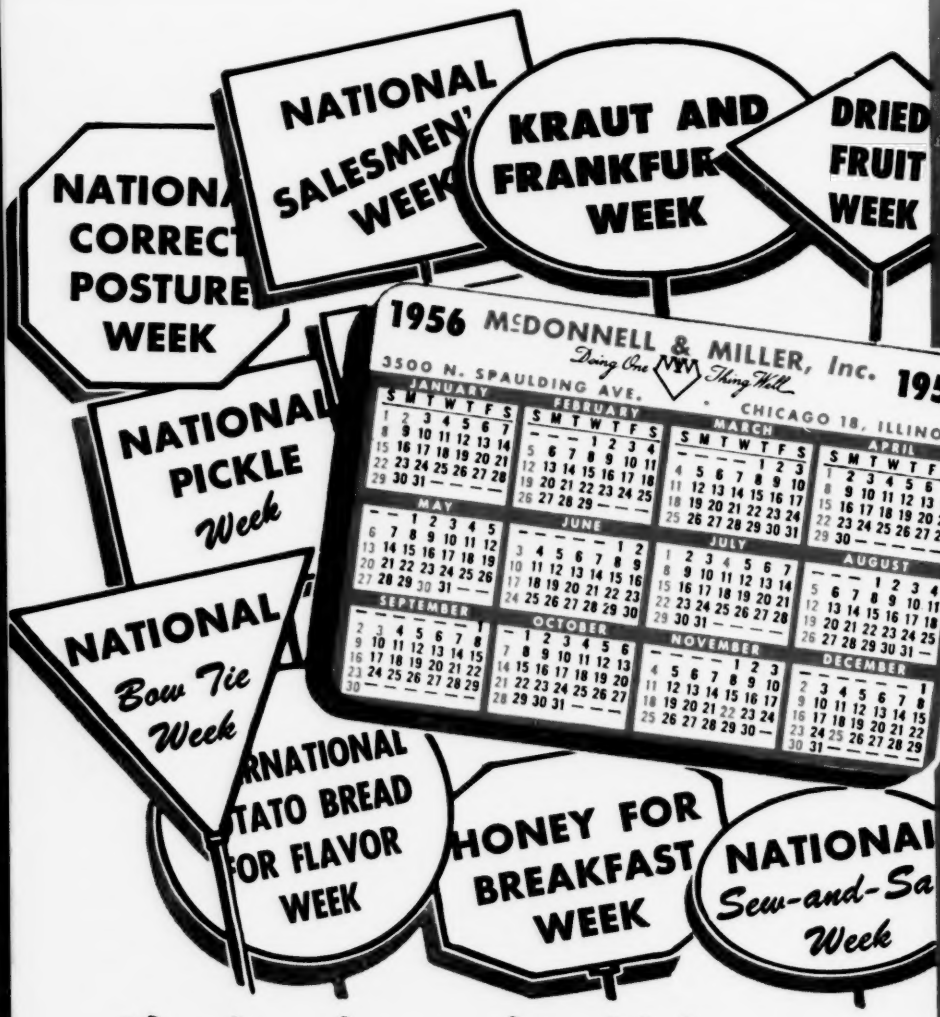

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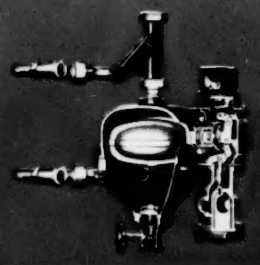

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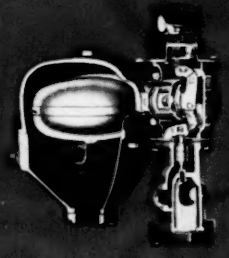

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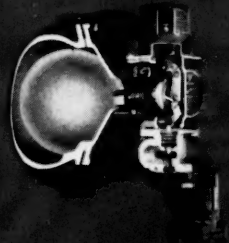

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